

A technical and tactical assessment of lineouts in National 2 SE Rugby Union: Can successful lineout performances be predicted?

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Abstract

The lineout is one of rugby union's most decisive set pieces, frequently shaping both possession and scoring opportunities, yet research into its technical determinants remains limited. This study was conducted to identify key variables (pitch location, match time, how stolen, catch type, weather, pitch type, rep time, lineout numbers, lineout formation, plus one, dummies & switches, dummies & switches type, hooker, throw location, throw type, delivery type, calling language, tempo, defence jump, defence jump location) that influence the lineout in terms of success in a semi-professional league combining performance analysis frameworks with coach-driven insight. A mixed methods approach was utilised, involving qualitative insights from five experienced coaches that went on to inform the process of building a tagging panel on Dartfish (Dartfish 2024, Dartfish, Fribourg, Switzerland). The panel and Dartfish video analysis software was then used to process 660 lineouts from the 2024/25 National 2 South East League using footage taken from the 26 games played by Tonbridge Juddians RFC. Categorical values were converted into nominal values and descriptive statistics (counts and percentages). The data were then imported into SPSS (IBM SPSS software, Chicago, IL) for multinomial logistic regressions to be performed in order to examine associations between each variable and outcome category (won, won-scrappy, loss). Model fit and predictive power were assessed using chi-squared statistics, Nagelkerke pseudo- R^2 and standard regression outputs including B coefficients, odds ratios, standard errors, Wald statistics and 95% confidence intervals. Results demonstrated that lineouts involving 6-8 players increased odds of success when compared to formations including 3-5 players (OR = 1.94, 95% CI [1.21-3.10], $p = .006$). The inclusion of a "plus one" significantly improved outcomes (OR = 1.68, 95% CI [1.12-2.51], $p = .014$) while front throw locations were also favourable (OR = 1.73, 95% CI [1.05-2.85], $p = .031$). In contrast, the presence of a defensive jump reduced the likelihood of winning clean possession (OR = 0.56, 95% CI [0.37-0.84], $p = .005$). External variables such as weather, pitch type, and time in match were all non-significant ($p > .05$). These findings highlight the tactical advantages of larger formations, strategies involving plus-ones and throws to the front, while confirming the disruptive influence of defensive contesting. Despite limitations relating to categorical sparsity due to a wide set of variables and single league sampling, this study offers a comprehensive

quantitative evaluation of lineout performance, providing practical insights for coaches and validated framework for future research.

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Definitions

PA: Performance Analysis

PIS: Participant Information Sheet

PI: Performance Indicator

KPI: Key Performance Indicators

Avg: Average

ICC: Intraclass-correlation coefficient

D/S: Dummies and Switch(es)

OR: Odds Ratios

SE: Standard Error

95% CI: 95% Confidence Interval

Chapter I: Introduction

Performance analysis (PA), despite its prominence within research, is a constantly evolving concept that has become a staple within the current professional and semi-professional sporting world (Wright et al., 2014). The concept of PA has been defined “as a method of quantifying and interpreting technical, tactical, physical and mental aspects of an athlete’s or team’s performance” (O’Donoghue, 2014). The earliest recorded instance was the use and development of a comprehensive notational analysis system by Charles Reep in 1950 for Swindon Town FC (McGillick et al., 2024). With this initial use arguably being the catalyst for the use of PA within the team sports sector, the integration of PA into sporting clubs has skyrocketed. One of PA’s prime purposes is feedback, which is taken from matches or performances, and this feedback often comes in the form of statistics, and clips/highlights from footage (Croft et al., 2021). The increased noted usage of performance analysis stems from the persistent desire belonging to coaches, sports scientists and athletes to gain a slight legal advantage over their opponents (Neville et al., 2008), and make more coach-driven, informed decisions (Hughes and Bartlett, 2002). This type of information can also be used to enhance other aspects of a team’s performance and strategy through assisting coaches in developing game and training plans (Woods, 2016). Notational analysis is proven to be a tool used by elite and semi-professional coaches and typically relies on the use of specific key performance indicators (KPIs) for structure and specificity (Wright et al., 2012).

KPIs are an important tool used during most forms of performance analysis and have been defined as “measurable actions or behaviours that can be measured during performance” (Hughes and Franks, 2004). While previously KPIs typically referred to technical variables, in more recent years these measurable actions or behaviours have been further stratified into physical (i.e., sprint time, heart rate or work rate) and tactical variables related to the specific sport in question (Perl and Memmert, 2018; McGarry et al., 2013). KPIs have their uses in all sports, especially rugby, with Parmar et al. (2017) placing emphasis on determining performance indicators (PIs) and KPIs within rugby league. Parmar et al. (2017) established that current form, amount of possession and quick plays all had a greater effect on the game outcome (win versus lose) and points difference. This, however, is only related to rugby

league and while this and rugby union are sports of the same name and nature, they possess a variety of differences and will rely on differing KPIs.

Like all invasion games and team sports, Rugby has KPIs relevant to the demands of the sport (Hughes & Bartlett, 2002). These KPIs exist to serve as tools for individual analysis, with inter positional differences being one of the factors driving this (James et al., 2005), as well as taking the form of overall inter match variables within team analysis (James et al., 2005; Watson et al., 2017). However, due to the nature of most invasion games, including rugby union, being team performance driven, analysis is typically team-based, with research also often focusing on team-based KPIs. A study by Jones et al. (2004) showcases a range of more general performance PIs that can be associated with the team, such as turnovers, handling errors, breakdown and set piece performance (inclusive of the lineout). Using these relevant KPIs, it is possible to predict both individual and team outcomes (win/loss) using statistical tests, with the aim to assist positive match outcomes (Jones et al., 2004). The lineout, counting as a set piece, relies on team KPIs to determine success as well as unit based KPIs including all the participating players (i.e. formations, success rate, (Migdalski and Stone., 2019; Franken et al., 2017; James et al., 2005). Therefore, understanding what the KPIs are for a successful line-out can aid in determining and even predicting successful lineout and overall performances.

The lineout is one of the most common set piece events to occur in rugby union and contributes to a large part of the offensive aspect within a game. A successful lineout is dependent on the accuracy of ball delivery to the hands of a player jumping/ being lifted by two team mates on the same team (Faelli et al., 2019), however, a number of factors can affect this action and outcome. Studies have investigated the event of lineouts; however, these have focused on the biomechanical aspects of a lineout such as Trewartha et al. (2008) and Sayers, (2011). Another study by Migdalski and Stone (2019) compared the lineout performance of the top and bottom four teams in the 2016-17 premiership finding that the overall success rate of lineouts between the sample teams did not differ (87% top) and (85% bottom) suggesting that success rates of lineouts is comparable across of teams of differing quality, which could be due to the structured nature of this event. Migdalski and Stone (2019) did however find that the top teams were successfully stealing ball from opposition lineouts at a

greater extent than the bottom (17% top, 9% bottom). Whilst current research may have identified lineout success rates do not differ amongst teams of different quality, there is a dearth of such research that specifically isolates the lineout as an event and investigates the key technical and tactical variables that underpin in detail successful lineout performance. This represents an important gap in the literature, particularly given the role of the lineout in possession retention and attacking structure (Migdalski and Stone, 2019). From a practical perspective, this lack of lineout-specific evidence limits the ability of coaches and performance analysts to make informed, evidence-based decisions regarding lineout strategy, training design and oppositional analysis. This is especially relevant within the National 2 SE semi-professional context, where limited resources heighten the importance of targeted and efficient performance interventions. Therefore, the present study seeks to address this gap by identifying the key variables associated with successful lineout performance.

Chapter II: Review of Literature

2.1 Performance Analysis and Performance Indicators in Rugby Union

2.1.1: An Overview of Performance Analysis

While PA can be traced back to the 1950s, with its first recorded use with Swindon Town FC, recent research has revealed that its roots go further back (McGillick et al., 2024). A previous study by Eaves (2015) found evidence of its development in the mid-nineteenth century, where the earliest forms of notation are said to have taken place, appearing within newspapers, periodicals and contemporary specialist books of the time. Throughout PA's history there have been developments of a wide range of new, specialised techniques that have distinguished themselves from classic notational analysis (Passos et al., 2017). Passos et al. (2017) highlighted several key analytical methods within sport performance analysis, which consisted of notational, biomechanical, tactical, psychological and social, physiological, environmental and contextual and interactive and team dynamics analysis. This boom in the development of techniques can potentially be linked to the increased interest in PA due to improvement and increased implementation of technologies (i.e. tracking systems, video tracking and improved video analysis systems) within team sports (Hughes and Franks, 2007).

Video analysis is a method that has benefitted greatly from the improvement of technology and thus improved the process of feedback to players and coaches, via the combination of quantitative analysis and video footage (O'Donoghue, 2009). This method provides a reliable report on matches that can be integrated with all forms of analysis highlighting its potential for extensive use (Hendricks et al., 2020). The previously mentioned increase in technology has also had a noted impact of video recording methods with the proliferation of various methods such as static analysis using stationary cameras, and dynamic and complex analysis in which the camera adjusts and moves itself to allow the capturing of various angles (O'Donoghue, 2009). Data collection, mirroring the video recording has also improved due to technological advancement. The primary improvement is through ability to record data in "real-time" via wearable tracking equipment, live video transmission to

analysts, integrated software platforms (i.e. Catapult, STATSports and Hawkeye) (Giblin et al., 2016). The main effect of these technological improvements has been the greater accuracy and objectivity of data collection removing a large proportion of reliance on human memory and observation (Ortega and Olmedo, 2017).

While PA within rugby union has become an increasingly integral part of the sport, the nuances of its insights are still not well understood (Colmer et al., 2020). While it can be argued that there is great use and advantage of PA, the lack of funding within rugby union, attitudes from coaches and the lack of research can be attributed to it varying attitudes towards its usage as well as its reliability. Funding is a challenge faced among all clubs within the sport however, it is the lower levels that can place very little or nothing towards PA (Painczyk et al., 2017). Painczyk et al. (2017) expands upon this stating that requirements associated with PA, such as equipment, software, and personnel, all require large amounts of funding that are simply not possible to accrue within the lower levels of rugby union. Alternatively, it can also be related to individual coaching philosophies as well as their experience with higher-level coaches typically engaging with PA at a greater level (Kraak et al., 2018). While Callinan et al. (2023) also stated that a lack of integration with coaching philosophies as well as improvement in PA literacy were issues with engagements, it is also the general attitude towards PA such as a fear of over reliance of data that may deter increased usage. The lack of research surrounding this area may well explain why usage depends so highly on coach experience and philosophy affecting the selection of variables, or KPIs, used in PA (Giblin et al., 2016), but this does highlight the importance of well-defined PIs and KPIs within notational analysis processes.

2.1.2: Performance Indicators

PIs are synonymous with early origins of PA, with the first usage of KPIs dating back to the first recorded use of notational analysis in the 1950s (Pollard, 2002). From that point on, the usage of PA, and subsequently PIs has increased exponentially, with a noted increase in reliance on statistical models between 1986 and 2016 (Sarmiento et al., 2018). Sarmiento et al. (2018) noted that an increase in research within the area yielded an increase in PIs within football after 2010, allowing for standardised or common PIs to be established. Another study identified and described the performance profiles of NBA players via the use of PIs to assist coaches to produce

and refine team models to optimise player use in different stages of the tournament (Dehesa et al., 2019). While similar to PIs; KPIs can be distinguished as a broader overview of performance via various metrics with greater specificity to overall success, player performance and accommodating for strategic decision making (Sarmiento et al., 2018). These KPIs allow for the objective quantification of a performance, which can be a team overall or scaled down to an individual player's performance (Parmar et al., 2017; Butterworth et al., 2013). Another notable use is to track time-dependent performance trends in athletes or teams (i.e. performance profiles) or even to compare individuals or teams within a group to generate rankings (Perl and Memmert, 2018).

While most KPIs based studies prove the usefulness of utilising them within PA in sport, there are several drawbacks that can be attributed to them and the research that they are often based upon. One being that KPIs consisting of quantitative data can also potentially overlook the subjective and context-driven qualitative aspects of a performance, such as temporal organisation, cognitive processes and coordination and team dynamics (Letsgrowleaders, 2012; Poizat et al., 2013). The overlooking of qualitative data related to a player's performance can skew the overall conclusion drawn by coaches, as unmeasured positive aspects are often forgotten (Swift, 2019). Another drawback highlights that the over-simplification of complex activities, which can assist with focusing on the event, will increase the risk of missing the impact of interconnected element of performance, such as team dynamics and psychological states (O'Donoghue, 2009). This is why a wider and more specific sets of KPIs are needed to determine the outcomes of sports performance, as discussed earlier.

There is also a lack of standardisation related to the tailoring of KPIs to players/teams, and whilst this does potentially increase the effectiveness of the KPIs, it can also limit the translation of them to other individuals or even sports. Research by Mackenzie and Cushion (2013) furthered this and identified the 'theory-practice gap' as being one of the main issues within football as a lot of the analysis research had a lack of transferability to the sport itself, as well as between sports and to the KPIs themselves. Another limiting factor explored by O'Donoghue (2009) highlights human error or bias within observation studies as well as when they are implemented. Despite these identified issues, the use of KPIs within tagging panels and within research is still widespread proving their effectiveness. To therefore improve the reliability of these KPIs there have been a number of measures

developed. One such measure is ensuring that the KPIs are context specific to situations within the sport (Cummins et al., 2025). These context specific variables can either be determined or checked for validity via the usage of interviews with experts (i.e. coaches) prior to the creation of a tagging panel in order to boost the reliability of the KPIs (McCleery et al., 2024).

2.1.3: KPIS and Predicting Performances

KPIs are not only useful in evaluating past performances but also as an effective tool for predicting future outcomes (O'Donoghue, 2008). A growing part of the research has utilised various statistical methods such as regression analyses and odds ratios in order to identify which KPIS lead to greater likelihoods of success (Zhou et al., 2024; O'Donoghue, 2008; Zhang et al., 2020; Cummins et al., 2025). Logistic regressions have a broad selection of uses, classifying game decisions, quantifying influences on decision-making and even predicting performances (Baker and Kwartler, 2015). More specifically Baker and Kwartler (2015) utilized logistic regression to predict the likelihood of each team select passing or playing "rushing" tactics in the NFL with a 66.4% accuracy for Cleveland and 66.9% accuracy for Pittsburgh. Alongside the use of logistic regressions to predict performances, researchers can also assess the odds ratios of variables on performance. As explored by Cummins et al. (2025) odds ratios have been used to link certain rebound patterns with match success in netball (i.e. more defensive rebounds = increased win chance). Odds ratios can also be used in conjunction with logistic regressions that are aimed to predict match outcomes. Parmar, (2018) utilised this methodology, however this study found that confidence intervals for both beta coefficients and odds ratios showed large variation across teams as well as variables, therefore meaning the prediction model did not fit for more than one team. An alternative approach that may have yielded better results is idiographic analysis (individual/team-specific) instead of nomothetic (generalised) methods (Parmar, 2018). While both methods are a useful tool in predicting performance, it is their use in conjunction with each other that may potentially yield effective models.

2.1.4: Performance Indicators in Rugby Union

As previously discussed, analysts in rugby union can rely on both team and individual KPIs to gauge and predict performances, with several studies discussing this. A prime example is Jones et al. (2004) in which it was determined that lineouts

won on oppositions throw and tries scored were determining factors when it came to predicting performance outcomes. Another study by Bremner et al. (2013) used odds ratios derived from logistic regression to determine that a quick ruck speed had the greatest positive effect on performance, while territory also had an effect within the first 20mins of the game. Bremner et al. (2013) also went on to determine KPIs that were related to a negative outcome, these being slow ruck speed, lost rucks, handling and turnovers. Recently, Kvasnytsya et al. (2024) found that conversion success rate and offloads greatly increased the chance of winning, whilst missed tackles greatly decreased the chances of winning. Despite these studies concluding that a limited number of KPIs effectively predicted performance, it is key to note each study highlighted different KPIs affected match outcome. Given the wide variety of KPIs, it may be more effective to narrow the focus and increase specificity via following a specific set that would best predict success. However as highlighted, these KPIs need to be selected based on relevant variables related to the sport. Rugby union has a number of positions separated into two main classes (forwards and backs). James et al., (2005), highlighted the need for both position specific KPIs as well as forwards and backs specific KPIs, as they will reflect the unique demands of each position. James et al. (2005) found for team performances in open-play, offloads, turnovers, runs with ball in hand, tackles made, passes and defenders beaten were all highlighted as overall KPIs for match success. Whilst this study provides detail on overall team performance, it was noted that there is also a requirement for position specific KPIs. Therefore, James et al. (2005) also developed specific KPIs which were applied to grouped positions; kicking (backs) (successful kicks and unsuccessful kicks), lineout throwing (hookers) (i.e. successful throw-ins, unsuccessful throw-ins, lineout infringements), lineout takes (locks/second row) (i.e. successful take, unsuccessful take) and turnovers (backrowers) (i.e. turnovers won, turnovers lost/conceded). While rugby union has free flowing elements associated with it, it is important to understand the importance of the set piece, more specifically the lineout. Sayers, (2011) addresses this through analysing the kinematic processes of the lineout by determining three distinguishable roles; thrower, jumper and lifter. These were then assigned specific actions associated with their roles, such as throw accuracy, ball release velocity, consistency of technique (e.g., elbow/shoulder angles) and catching the ball at peak elevation with minimal adjustment (Sayers,

2011). These position specific KPIs allow for detailed assessment of individual and team performance during lineouts.

In the context of this research study, such specificity is vital. By assessing lineout-specific KPIs in relation to match outcomes, we can better understand how these technical and situational actions influence the likelihood of success. Through using logistic regression models, we can also begin to quantify the impact of individual lineout actions on the probability of success, as shown by a number of studies mentioned previously (Zhou et al., 2024; O'Donoghue, 2008; Zhang et al., 2020; Cummins et al., 2025). Therefore, analysing lineout KPIs not only supports set piece performance analysis but also directly contributes to the predictive validity of this study, helping identify the aspects of lineout performance that are most influential on success outcomes.

2.2: The Tactical and Strategic Aspects of Rugby Union

2.2.1 Tactical Analysis in Rugby Union

Rugby Union is a sport consisting of attacking and defensive play, these aspects are widely regarded as being equally important to winning a match. While it is these aspects that can lead to a positive result, it is often the related tactics and strategies within offence and defence that make up a large part of the game and can decide the outcome of a match (Colomer et al., 2020). This emphasises the importance of the development of tactics within this sport as well as the KPIs associated with them. Key aspects of play such as possession and the creation of space have been shown to be vital variables that determine the outcome of matches, with tactics developed to enhance their utilisation (Hughes and Bartlett, 2002; Parmar et al., 2017; World Rugby, n.d.). Despite the sport consisting of both attacking and defensive play, the primary focus on tactical development lays with the attack rather than defence (Colomer et al., 2020). Therefore, a deeper understanding of offensive tactics and their associated KPIs is essential for optimising performance and securing success within rugby union.

Attacking strategies are most often formed with the influence of how each team trains, and the coach, for example the implementation of unstructured possession sources (i.e. response to turnover possession) within training by the attack coach at Queensland Reds (2010-13) (McKay and O'Connor, 2018). This contrasts with the often-rigid attacking structure fostered within rugby, allowing for further adaptability

and creativity within play from players (McKay et al., 2021). This unstructured play however is limited as it requires space in which to work, this is where structure comes in as it allows for space to be created by combining depth as well as player placement (McKay et al., 2021). Therefore, as McKay et al. (2021) concludes, it is important to foster increased adaptability from structured attack (often from the set piece i.e. lineout) to unstructured play. The nature of rugby union requires defensive strategies to be formed in reaction to an opponent's offense, such as strategies that rely on defensive speed (up and out) or moderate line speed involving lateral shift in order to not provide any easy line breaks or overlaps (Hendricks et al., 2013). Hendricks et al. (2013) also mentions the ratio of defenders vs attackers call for a level of reactivity within defence, and it is this situational awareness that is most important within defence. However, while defensive strategies can be planned, it is a reactive defence that is primarily relied upon and therefore harder to control. Alternatively, there is more control found within offensive strategies, both in play and within the lineout. These offensive strategies in the lineout can in turn be developed from the assessing of an opponent's defensive strategies and can in turn be used to counteract a defence therefore potentially increasing success.

2.2.2.: Set Piece Analysis in Sports

Since assessment of set pieces, particularly from an offensive perspective, can be helpful in dictating successful strategies, it is relevant to assess the importance of set pieces across similar invasion games. A study within rink hockey assessed 6,920 set piece actions (free direct hits, penalty shots) utilising video analysis software and further data analysis to determine which form of set piece was responsible for the most goals (Cerrah et al., 2016). The most successful teams were found to score the most goals from these opportunities further highlighting the importance of the set piece (Cerrah et al., 2016). This study provides a great basis emphasising the importance of the set piece, however it does not provide a breakdown of what these teams are doing to increase their success. Various studies have therefore established and tested variables that may potentially affect the result of the set piece. A study under Fernández-Hermógenes et al. (2021) found that as well as external factors, specific KPIs related to the set piece such as reactivity to defence, delivery method and specific strategies were all related to the success of the set piece within football. Specifically, the breakdown of the delivery method such as

direct deliveries were often favoured over indirect deliveries in spite of a low shot conversion rate Fernández-Hermógenes et al. (2021). Interestingly, Fernández-Hermógenes et al. (2021) also found that ball trajectories, shot types e.g. headers, volleys or ground shots all had varied effects on the success of the set piece. This breakdown allows for coaches to establish which tactics, may work best in certain situations within the match. Despite its findings the study does not cover some of the more specific aspects related to the set piece that may be found in rugby union such as player numbers and formations.

2.2.3: Set Piece Analysis in Rugby Union

Set pieces in rugby union can be categorised into two independent sequential events, these being the scrum and the lineout. The scrum is an event that provides plenty of offensive opportunities, with both teams forward packs (8 players each) congregating at a marked spot on the pitch with each team's backlines setting up 10m from the back of the scrum individually. Wheeler et al., (2010) points out that this depth, roughly spanning 20m, allows for the generation of speed in attack which provides an upper hand over the defence. Another key benefit is also the time that is afforded to the attacking teams backs while the forwards organise. This time can be best used to prepare any pre organised (set piece) moves which are designed to utilise space and time to a greater degree with runner employing hardlines at pre-selected targets to dissect a defensive line (Wheeler et al., 2010). Specific opportunities are afforded to the forwards as well who are conducting the scrum or lineout. These can array themselves as either preplanned (i.e. mauls, specific lineout moves) and preplanned/momentary decisions such as pick and goes from the back of the scrum (Coughlan et al., 2019).

Although there are numerous methods of scoring in rugby union, i.e. scoring tries, penalty kicks and conversions, many of these scoring events in game can stem from the set piece, with the lineout being a primary source (Bunker et al., 2021; Migdalski and Stone 2019). The importance of the lineout as a potential scoring event is well known, and there is a multitude of research which has assessed and supported this. For example, Migdalski and Stone. (2019) found that the top four teams 2016/17 English premiership season scored an average 1.57 tries a match from a lineout, which was higher than the bottom four who only scored 1.10 from the lineout Coughlan et al. (2019) also found that the success of set pieces, primarily lineouts,

contributed to 38% of all tries, and scrums only contributing to 18%, therefore having a direct positive match outcome. Therefore, each of these events highlight the importance of the set piece within rugby's attacking nature, however it is the success of the set piece that allows for the possession which is required to score a try. Although tactical and strategical research is common within rugby union there is still a lack in tactical analysis related to the lineout despite its importance within the game

2.3: The Lineout in Rugby Union

2.3.1: The Importance of the lineout in Rugby Union

While the scrum and the lineout are both important features within rugby union, as suggested. it is the lineout that provides the greatest amount of scoring opportunities (Coughlan et al., 2019). This is true even at the highest levels, where the lineout was involved in 51% of tries scored within the 2015 Men's Rugby World Cup (Morris 2020). A lineout is an isolated set-piece event that is used to restart play after the ball has gone into touch, enabling a contest for possession that, if won, feeds into open play via a pass to the scrumhalf or a maul formation (World Rugby Passport, 2025; Rugby Dojo, 2021). It occurs when the ball is either dropped, thrown or kicked out of play by either team or the opposition being granted possession (Johnson, 2014). The exception to this is when the ball is kicked out because of a penalty kick awarded to either team and/or the ball is kicked out past the opposition's 22m line from the opposite half of the pitch (Johnson, 2014). This event entails up to 7 players from both teams stood in parallel lines 1-2m apart and 5m from the sideline contesting over a ball as it is thrown in between them (Morris, 2020). This contest primarily takes place between two lifted "jumpers" (trying to catch the ball), with contact between the jumpers being prohibited (Morris, 2020).

The lineout as a technical event can often be predicted through suitable opposition analysis of team's performance, with performance disparities also being present amongst teams of different quality. As evidenced by Migdalski and Stone (2019), who found that the most successful teams within the premiership had a better turnover ratio when defending lineouts. Therefore, to mitigate this potential predictability and performance disparity there is a necessity for well-rehearsed, varied and non-linear lineouts to create the most clean ball and attacking opportunities (Hughes et al., 2012). However, whilst research has highlighted the importance of this event, the lineout is still a relatively under researched area of the game in terms of variables

that may affect its success. While there have been a few studies that do assess this, most notably Morris (2020) and Colomer (2020) whom both propose various variables that can affect success, they focus on specific variables, and not a general set that can be applied to all lineouts.

2.3.2: Variables Affecting the Lineout

One key component of the lineout that has been assessed within the research is the use of different throwing distances (front, middle, back), which can yield an increased chance of success. For example, a front throw travels a shorter distance and is therefore quicker and easier to catch whilst the drawback is that it limits attacking space and increases passing distance (Sayers, 2011). The middle would be classed as a default, or a check out move balancing attacking benefits and throwing distance/ease of catching (Sayers, 2011). A back throw requires a more technical throw from the hooker but provides the best attacking space with shorter passes being required in the backline (Sayers, 2011). Differing distances can be combined with other methods such as potentially using “dummy lifts”, used to trick an opponent to intercept the ball at the wrong space (Sayers, 2011). The compartmentalisation of the lineout into front, middle and back is important as they provide the basis of KPIs related to differing tactics within the lineout and therefore provide information on the success rates of each compartment.

Moreover, mauling is a tactic widely used by teams within rugby union, often stemming from a lineout in which it is formed when a jumper has landed on the ground with teammates binding on and pushing against another team (Sayers, 2011). While it is the lineout that is often credited with the scoring opportunities ranging from 37%-38%, it is the maul that is a common strategy used when scoring, which highlights its importance (Jones, 2013; Coughlan et al., 2019). Moreover, Jones (2013) found that tries from lineouts were scored the most frequently within the oppositions 22m (Red Zone). Jones (2013) also suggested that the opposition 22m is an ideal zone for mauling, thus suggesting that tries were scored the most often in these zones not from not the lineout itself, but the mauls that came from the lineouts. However, there is little research to support whether this is truly the case.

However, research that has assessed the variables affecting the success of a lineout itself is limited despite being one of the most important aspects of the game. The predominant portion of these studies have a mixed focus of determining specific

variables affecting the lineout. A prime example of this is a systematic review by Colomer et al. (2020), which assessed the analysis of attacking and set piece variables among other performance factors. The review identified that despite there being numerous performance indicators that can contribute to success, the majority of studies examined in this review relied on isolated measures, and failed to sufficiently account for contextual factors. From this then, several contextual variables relevant to the lineout were identified, these included; field location, phase of match (early, mid, late), scored differential, team and opposition ranking (perceived own strength vs opposition) and number of players involved. Where contextual factors were considered, findings suggested that set-piece success, including lineouts success, was influenced by situational demands such as field position and opposition quality, with winning teams more likely to achieve success on opposition lineouts in key field zones. However, Colomer et al., (2020) highlighted that these relationships were rarely examined in combination, limiting the ability to determine how contextual factors interact to influence lineout outcomes. Consequently, the review concluded that the further adoption of contextual variables related to the lineout, and within match play more broadly, is essential for improving the understanding and application of performance analysis in rugby union. While Colomer et al., (2020) only highlighted a limited number of variables, their presence in a more recent study by Zanin et al. (2021) further corroborates the validity of these variables. Zanin et al. (2021) suggested oppositional analysis should be considered as an important factor in the identification of contextual variables that may influence lineout performance, such as player numbers and pitch dimensions. These findings indicated that difference in opposition structure and available space can alter lineout organisation and decision making, potentially constraining lineout option and affecting success rates. Furthermore, several situational variables related to the composition of the lineout have been shown to affect success depending on the proficiency of the hooker (thrower). For example, Sayers, (2011) reported that the throw height (avg: 3-3.5m) and the distance (avg: 5-18m) differed depending on the players involved and the moves employed within that specific lineout. These variations increase the technical and perceptual demands place upon the hooker, as greater accuracy and consistency are required to adapt the throw to changing lineout configurations thereby reinforcing the notion that the hooker is central to the success fo the lineout (Sayers, 2011). Finally, a study by Morris et al., (2015) investigated

lineout tactics in high-performance rugby union analysing 2,211 lineout from the 2014 Super Rugby season. This study examined a wide set of variables including field position, number of players in the lineout, throw accuracy, direction of jumper movement and defensive contest. The findings indicated that while throw accuracy remained the strongest determinant of lineout success, contextual and tactical factors such as field location, lineout composition and pre-jump movement patterns (dummies and switches) also influenced success rates. Notably, lineouts executed in the attacking and defensive 22m zones used static lineouts to greater extent as well as experiencing a higher rate of success from static lineouts. This reinforces the importance of evaluating lineout performance through a multivariable, context-dependent approach rather than isolated indicators.

These studies provide greater insight into the variables affecting performance, either in or around the lineout in rugby union, however the level of play that the studies focussed on reduce the applicability of these variables to lower levels. Colomer et al., (2020) reviewed studies only focussing on elite senior male rugby union matches, in both domestic and international match-play contexts. As a result of this, the contextual value of the variables is only based within this level of rugby, where the competitive performance environments contain the most developed levels of tactical decision making and structured set piece performance. In contrast to this Zanin et al., (2021) reviewed studies that included a broad range of playing levels, spanning from youth, academy, semi-professional and elite players across both rugby union and league. However, a majority of these variables were drawn from junior or developmental sides that used small-sided game environments rather than competitive matches. Consequently, these findings were limited in their applicability to match play at any level. Sayers, (2011) investigated a very narrow but highly specialised elite sample, consisting of three international-level rugby union players (hookers). Unlike the two review studies, this research focused on individual-level biomechanical analysis within a controlled, lineout related task making it relevant to this study, however its small sample size and hooker related research limits it in the context of this study and the lineout as a whole. Moreover, the study by Morris et al., (2015) used a smaller set of variables that were specific to the lineout in elite level rugby union. The sample came from Super Rugby in the southern hemisphere. This study considered a number of variables, such as number of players, location on the

field, game time, pre-throw jumper movements and throw type and location, in which it was revealed that lineout success was multifactorial and unable to be predicted using parametric and nonparametric statistical testing. The limited scope of these studies therefore highlights the need for an investigation assessing a wider selection of lineout related variables for performance prediction. Moreover, the sample these studies used limits applicability to lower levels of performance, therefore highlighting the importance of this investigation.

2.4: System Development and Validation

2.4.1: Coach Integration in the Analysis process

As denoted earlier, the analysis of a lineout requires a standardised set of KPIs and variables in its assessment, therefore, a suitable tagging system should be developed. Coaches have been shown to play a crucial role in the performance analysis process, particularly in shaping the selection and prioritization of KPIs (Wright et al., 2012). Their practical experience, tactical understanding, and intimate knowledge of their teams' strategies allow them to direct analysts towards the collection of both contextually relevant and applicable indicators. Wright et al., (2012) highlighted the importance of coach integration within the process, highlighting that coach input ensures KPIs are aligned with performance goals and game plans rather than relying solely on generic or overly technical metrics. Rogers et al., (2022) employed this methodology withing a recent study where elite basketball coaches led the identification, rating and selection of both performance indicators and the best methods of measurement. This highlights the importance of coach involvement not only in the analysis process, but also in the validity checking of KPIs, and their subsequent assessment.

2.4.2: Methods of Tagging Panel Development

Previous research has employed a range of methodologies to develop and implement tagging systems in sports performance analysis. Within team sport contexts, bespoke tagging panels are commonly developed through expert led processes in which sport-specific technical and tactical variables are identified, operationally defined, and manually coded, followed by formal assessment of inter- and intra-observer reliability. For example, Tenga et al., (2009) developed a new

team match performance framework for professional football utilising multidimensional categorical variables that captured the interaction between opposing teams. The reliability of this system was evaluated by using inter- and intra-observer agreement testing, demonstrating acceptable to very good reliability for the majority of variables and highlighting the necessity of reliability assessment when introducing novel and performance analysis methods (Tenga et al., 2009).

Simialry, Francis et al., (2019) employed a sequential expert driven process to develop a performance analysis template in elite wheelchair basketball. Action variables were refined through consultation with experienced coaches prior to undergoing formal reliability testing. This approach ensured that performance indicators were both contextually meaningful and consistently applied across observers, reinforcing the value of coach expertise in tagging panel development. Comparable expert-led methodologies have also been reported in individual combat sports, where practitioners and coaches collaboratively defined offensive and defensive performance indicators that were subsequently subjected to structured inter- and intra-observer reliability analyses. Another example is a study by Thomson et al., (2013) in which they also employed a comparable expert-led approach in amateur boxing, both defining offensive and defensive performance indicators with coaches, actioning them, and evaluating both inter- and intra-observer reliability using post-event video analysis.

More recently, semi-automated machine assisted approaches have been proposed to improve tagging efficiency (Deng et al., 2021; Giancola et al., 2023). However, these methods typical require large, annotated datasets and may lack contextual sensitivity required to capture complex, opponent dependent behaviours. Due to this, the present study will adopt an expert driven manual tagging approach, underpinned by established validity and reliability procedures, to ensure that lineout performance indicators are both ecologically valid and consistently applied within a NAT 2 rugby union context.

2.4.3: System Development Using Expert Opinion

When developing tagging systems, analysts or researchers may be able to look to previous research to define relevant KPIs, however, when this is not available, coach and expert opinion can be invaluable in the development process (Hendricks et al.,

2020; Mackay et al., 2023). Research, not just within sport, will often use subject experts to define or clarify important variables within frameworks, and this method can be typically seen within Delphi studies. For example, while assessing aspects of female athlete health, performance and wellbeing McCleery et al. (2023) employed a split panel of experts, ranging from those directly influenced by the study i.e. female athletes, and a panel of researchers and practitioners. This study involved 40 female athletes who answered health related questions using a Likert scale (1= 'strongly disagree' and 5= 'strongly agree') and a verbal justification to determine the importance of each aspect of health as well as suggest new topics for inclusion. The quantitative rankings were then processed with the qualitative justifications following (McCleery et al., 2024). Another study employing a Delphi consensus model utilised a diverse group of researchers and practitioners that were part of the Rugby Union Video Analysis Consensus (RUVAC), these practitioners were then asked to review and rate the clarity and appropriateness of definitions for rugby specific KPIs (Hendricks et al., 2020). The most common form of methodology contains an interview process in which subject matter experts are asked to rate variables which are then applied to a coding panel within video analysis (Hendricks et al., 2020, Mackay et al., 2023). This can especially be applied to lesser researched sports that can't rely on surrounding literature to provide justification for coding panels, such as the lineout in the rugby union.

Furthermore, in order to check validity, the use of expert focus groups have been used to discuss the suitability of analytical models. A prime example of this is Lowe et al. (2025) who employed experts to highlight unsuitable items and suggest alternatives within a player performance profile coding panel. This approach ensures the validity of an analytical coding panel through using coach opinion, therefore grounding it with real world expertise and practical relevance, ensuring the panel accurately reflects meaningful aspects of player performance.

2.5 Aims

While several studies have worked towards establishing lineout variables and their effects, i.e. throw distance, the thrower (hooker), dummy manoeuvres and the various plays off delivery (mauling) (Sayers, 2011; Jones, 2013, Coughlan et al., 2019), the existing research does not provide a comprehensive set of such variables,

nor are the overall effects on lineout outcome assessed. As evidenced in this review, there is a dearth of such research, so, a comprehensive assessment of what lineout variables have significant effects on lineout outcome is necessary. Therefore, the aim of this study is establishing a broad and extensive list of these variables, clarify their validity with coaches and other subject experts, and then assess the effects of these variables on overall lineout and delivery success. From this, it can be highlighted what variables are the most important to consider when conducting and assessing a lineout, which can aid in enhancing specific lineout coaching and feedback, and analysis processes. As research within rugby is limited investigating performance at this level will allow teams to discover how they can potentially improve their lineout performances and develop their skills to reach increasingly higher performance levels.

Chapter III: Methods

This study is a mixed-methods study, using both qualitative and quantitative methods. Firstly, subject matter experts were contacted and recruited to help inform the tagging panel creation process. Next, a tagging panel was developed and created using this expert opinion. This panel was then used to assess lineout performances in rugby union and assess which variables had higher likelihoods of success. The study received institutional ethical approval from the University of Kent's Research Ethics Advisory Group.

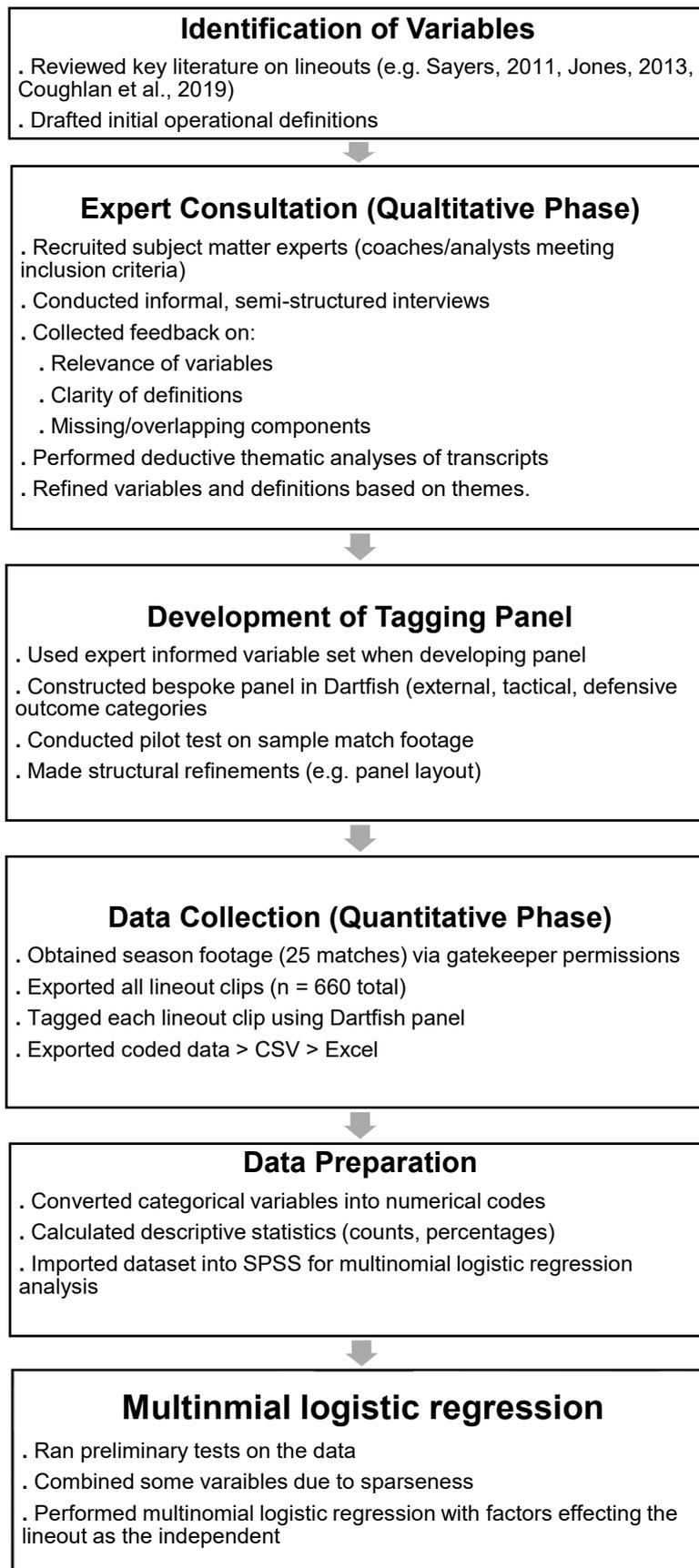


Figure 1: A flowchart summarising the methodological process within this study.

3.1: Qualitative Methods

3.1.1: Informal Interviews

3.1.1.1: Participants

For this study, 6 experts were recruited via email and informally interviewed. To be included, each coach had to qualify within one of the listed inclusion criteria; (a) a current coach/analyst/player in a professional or semi-professional setting (National 2 or higher), and/or (b) has a minimum of 3 years' experience at a professional level. These criteria were taken and adapted from a recent study by Scantlebury et al. (2022). All participants read a PIS informing them of the interview procedure and signed a consent form prior to participation.

3.1.1.2: Procedure

Firstly, six key papers (Migdalski and Stone, 2019; James et al., 2005; Sayers, 2011; Hughes et al., 2012; Jones, 2013; Coughlan et al., 2019) which all assessed the lineout in some capacities were assessed and read. Each paper noted key variables that make up the line out, for example, defensive lift, hooker, throw location, dummies and switches (D/S) and delivery type. These were used to aid in the development of key definitions that were discussed with coaches. Using this, and the authors previous knowledge as an experienced analyst in Rugby Union, a list of dependent variables consisting of aspects relating to the lineout was formed, for example, tactics used, personnel, formation, tempo, calling language as well as some external variables consisting of location and the weather. Definitions of these variables were created and developed, and were put forward to the experts via informal, unstructured interviews (M= 31 minutes). Interviews followed an informal guide consisting of a brief round of questioning related to the proposed variables followed by discussion centred on unlocking deeper insight into their applicability and relevance to the study. During the interviews, the researcher showed the experts the proposed definitions, asking initially, “do you agree with this set of variables?”, “is there anything you would take away from this list?” and “is there anything you would like to add?”. Based on participant responses, conversations then ensued which were unstructured and explorative in nature.

All interviews were recorded at the consent of the participants, and participants were reminded that their answers would be anonymised, and that there were no right or wrong answers.

3.1.1.3: Data Analysis

All interviews were transcribed verbatim. Transcripts were checked and verified by the lead author after the interviews by re-watching the interview recordings and comparing and verifying against the created transcriptions. A deductive thematic analysis was conducted to notice where coaches agree or disagree with definitions, add anything to definitions, or add any variables to the pre-existing list.

Conversations also took place around each variable, as well as determining links between them. A deductive thematic analysis was conducted on the transcripts to look for themes and trends in the data via the use of a qualitative research software called NVIVO (QSR International, 2022). These variables were then applied to a flow-chart establishing themes and subsequent codes using inspired by the earlier Braun and Clarke (2006) study. The results of the thematic analysis were then used to inform the framework and tagging panel. All discussed and defined variables from the interviews can be seen in section 3.3.

3.2: Quantitative Methods

3.2.1: Tagging Panel Development and Use

3.2.1.1: Sample

Notational analysis was completed on Tonbridge Juddians (TJs) RFC (National 2 side) footage, and their respective opposition, across 26 games over the 2024/25 season. In total 660 lineouts were analysed including both TJs ($n = 350$) and Opposition lineouts ($n = 310$). A number of variables (e.g. rain, 2+ D/S) with no recorded instances were excluded from multinomial logistic regression testing to ensure valid coefficient estimation and model convergence. While concerns about small-sample bias in multinomial logistic models are common (Kanal and Chandrasekaran, 1971). Research surrounding these issues proposes a notion that ~10-15 observations is an acceptable minimum sample size for multinomial logistic testing (Kanal and Chandrasekaran 1971; Peduzzi et al., 1996). Therefore, the size of sample yielded by this study implies accurate testing.

3.2.1.2: Procedure

Fixture footage was accessed from the TJs database via gatekeeper permissions (see attached gatekeeper letter in appendix). Match footage was then downloaded and imported into Dartfish (Dartfish 2024, Dartfish, Fribourg, Switzerland). Using this software, a bespoke tagging panel was created (Figures 1, 1a and 1b). From this match footage, clips of every lineout were created for analysis, which then compiled into montages and then exported and stored for further analysis. These clips were then reviewed and tagged with each variable. All fixtures were coded post-match by the lead researcher (who had 2 years' experience working as an analyst). Before actual data collection, a match from a previous season was analysed as a pilot to test for any issues with the coding panel as well as the storage of data within the spreadsheet. Once all games were coded, data was converted CSV (comma separated values) files and imported into Microsoft Excel. (Microsoft Office 365, Redmon USA).

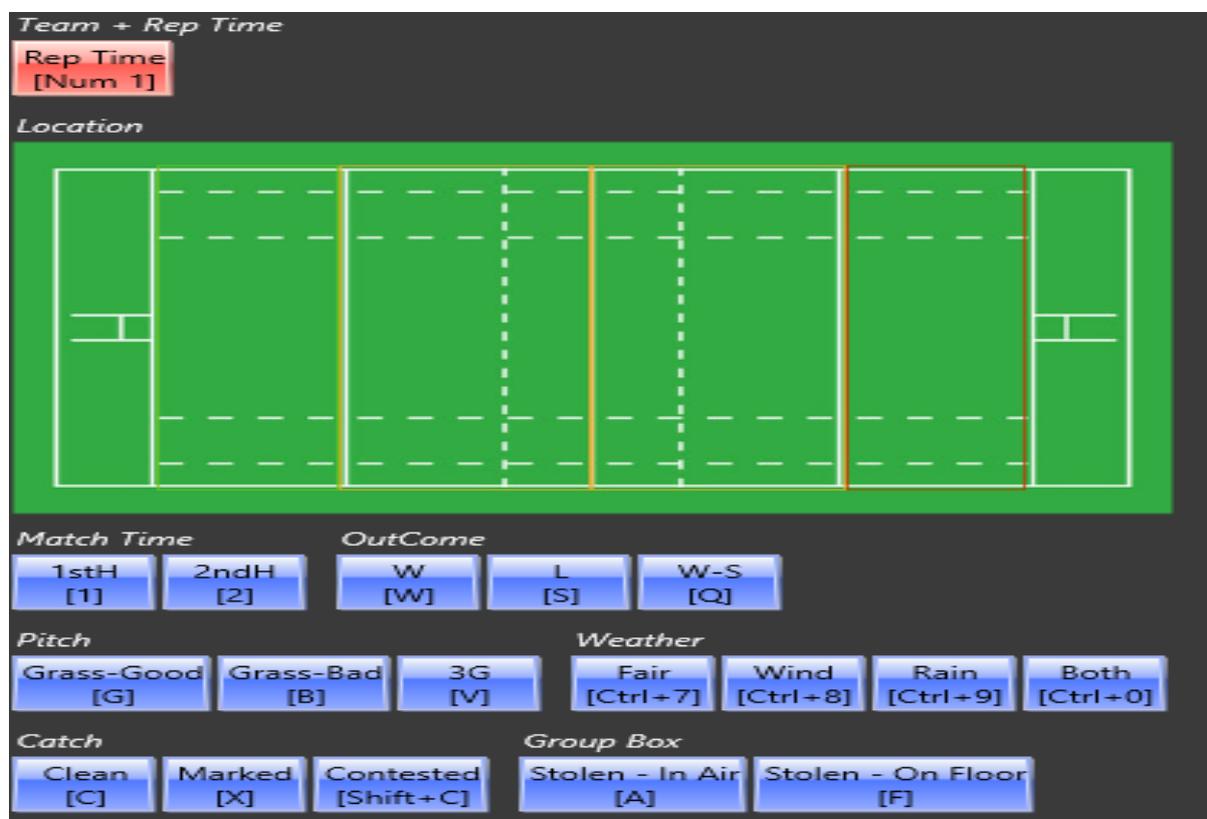


Figure 2: Display of the External Factors Section of the Coding Panel.

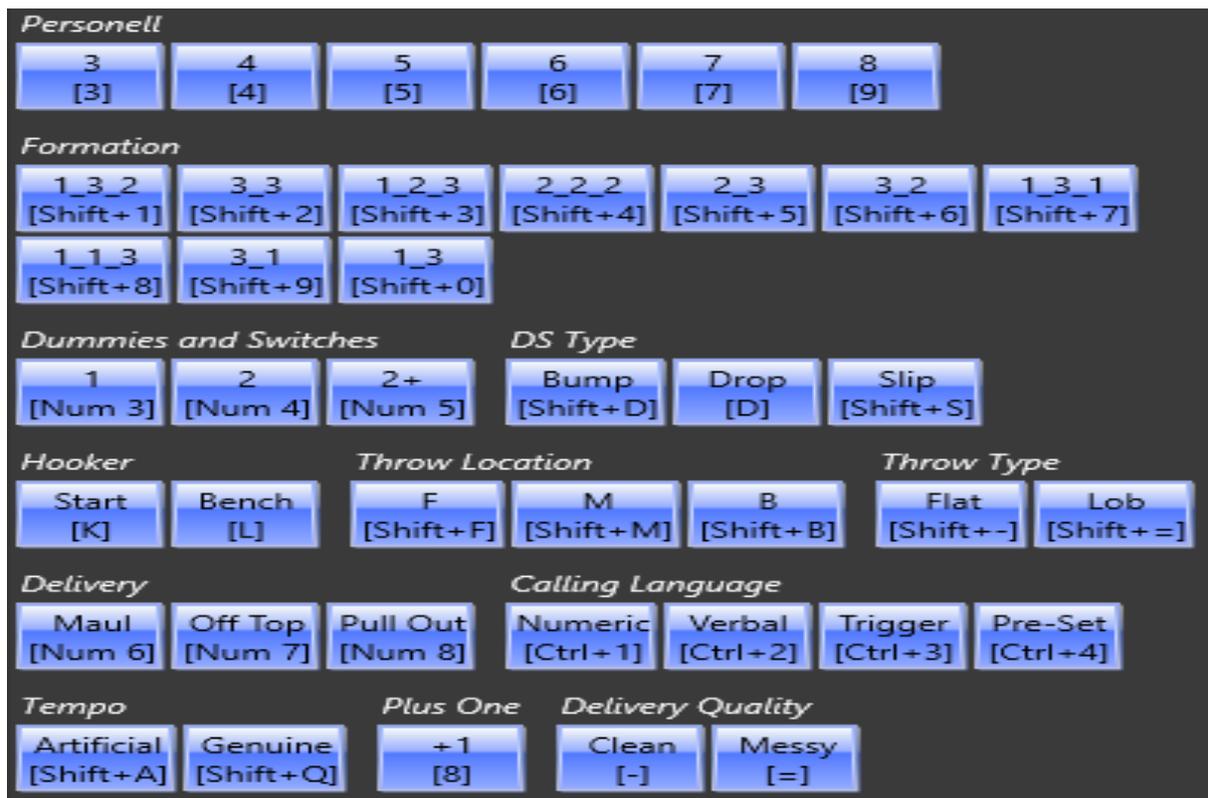


Figure 2a: Display of the Tactical Factors Section of the Coding Panel.

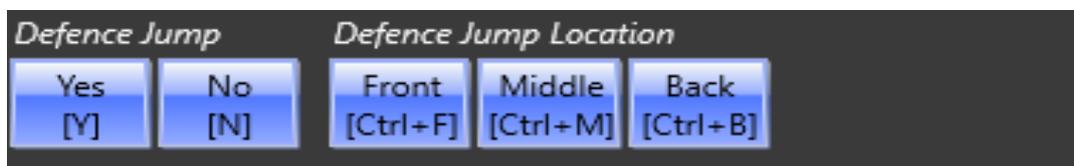


Figure 2b: Display of the Defensive Factors Section of the Coding Panel.

3.3: Operational Definitions

Table 1 shows the defined variables that were assessed and incorporated into the tagging panel. Establishing these definitions was vital to the reliability and repeatability of the testing phase of the study. This process ensured consistent operationalisation of each variable across all lineouts therefore enhancing reliability and reproducibility of the analysis(Williams, (2012)

Table 1: Depicts the names of each variable tested and a contextual definition.

| Variables | Definition |
|----------------|---|
| Team | Attacking team involved within the lineout. |
| Opposition | Defensive team involved within the lineout. |
| Pitch location | The specific location on the pitch the lineout would occur. |

| | |
|---------------------------|--|
| Match time | Time within game, split into halves (1 st Half, 2 nd Half). |
| Rep time | Time elapsed from the players trigger in the lineout to the catch. |
| Won/won-scrappily/lost | The outcome of the lineout in terms of possession success. |
| Lineout numbers | The number of players involved within each lineout |
| Plus 1 | The presence of a forward's player in the primary receiver channel instead of the scrumhalf |
| Lineout formation | The set up or arrangement of players within the lineout. |
| Dummies and switches | The number of manoeuvres used to deceive the defence. |
| Dummies and switches type | The specific type of deceptive manoeuvre used. |
| Bump | A deceptive manoeuvre where players dummy on the first player, front lift goes out the line. Players goes through and up one place ahead |
| Drop | A deceptive manoeuvre where players dummy on jumper up and out the line, player goes up directly behind |
| Slip | A deceptive manoeuvre where fast dummy on player so moves in the line and get lifted behind. |
| Defence jump | Whether a defensive jump occurred during the lineout. |
| Defence jump location | Location of defensive jump within the lineout. |
| How stolen | The method by which the ball was stolen within the lineout. |
| Catch type | The manner in which the ball was caught i.e. clean, marked, contested. |

| | |
|------------------|--|
| Hooker | Indicating whether a starting or replacement hooker was throwing in. |
| Throw location | The target area the hooker throws to in the lineout. |
| Throw type | The manner or technique of the throw I.e. lob, flat. |
| Lineout delivery | How the play was initiated from the lineout i.e. maul, pass off top, or maul pull out. |
| Delivery quality | The quality of the delivery within the lineout. |
| Calling language | The type of trigger/call used before prior to executing the lineout. |
| Weather | Weather conditions at the time of each lineout. |
| Pitch type | The type/quality of pitch surface. |
| Tempo | The tempo of the set up for each lineout. |

3.3.1: Validity and Reliability

Content validity of the tagging panel was established through expert review.

Following the initial design of the panel, the participants who were interviewed, and an experienced analyst operating in NAT2 East were invited to examine the panel's structure, operational definitions, and coding categories. The provided feedback was used to refine the variables to ensure that the panel captured performance indicators that were both representative and meaningful to the lineout and rugby union, i.e. it was suggested that each button should be separated into different sections of the panel based on which type of factor they represented (success, external, tactical and defensive) in order to streamline the process. Additionally, it was recommended that rep time be put on the first page in the success tab as that was a constant measure that was triggered first. This process mirrored the process of Lowe et al. (2025), who incorporated expert feedback within the design and validation process. The final created panel was deemed to reflect the tactical and technical elements most relevant to the applied performance environment in rugby union.

Reliability was tested using intra-observer techniques. To minimise the influence of familiarity and memory effects, the same researcher re-analysed 10% of the total sample (n=66 lineouts) more than six weeks after the original coding was completed.

Reliability testing was conducted on SPSS using intra-class correlation coefficient (ICC) analysis with a 2-way mixed effects model to assess absolute agreement. The ICC values ranged from 0.990-0.999 across all variables measured, indicating excellent reliability of the coding process and the tagging panel.

Table 2: Displays results from intraclass correlation coefficient (ICC) to determine reliability of coded variables.

| Variable | ICC |
|------------------------------------|------------|
| Pitch location | 1.000 |
| Match time | 1.000 |
| How Stolen | 0.999 |
| Catch type | 0.992 |
| Weather | 1.000 |
| Pitch type | 0.998 |
| Rep time | 0.993 |
| Lineout numbers | 1.000 |
| Lineout formation | 0.997 |
| Plus one | 0.998 |
| Dummies & switches | 0.996 |
| Dummies & switches type | 0.994 |
| Hooker | 1.000 |
| Throw location | 0.999 |
| Throw type | 0.997 |
| Delivery type | 0.998 |
| Calling language | 0.989 |
| Tempo | 0.993 |
| Defence jump | 1.000 |
| Defence jump location | 1.000 |

3.3.2: Statistical Analysis

Categorical data within the spreadsheet were converted into nominal values, with numerical values being used to represent different variables. Descriptive statistics were also calculated via the COUNTIFS function, and corresponding percentages

(%) were calculated. Data was then imported into SPSS (IBM SPSS software, Chicago, IL). To establish the associations between each variable and success (won/won-scrappy/loss), multinomial logistic regressions were run. Model fit was assessed using chi-square statistics, degrees of freedom and significance values ($p = 0.05$). Regression results were presented using B coefficients, $\text{Exp}(B)$ (odds ratios), Standard errors (SE), Wald statistics and corresponding 95% confidence intervals to reflect effect size and estimate precision. Additionally, model predictability was evaluated using the Nagelkerke pseudo R^2 value.

Chapter IV: Results

4.1 Descriptive Statistics

Tables 3, 3a and 3b present all descriptive statistics of the lineouts and assessed variables. This section has been structured and written based on variables R² values, with the highest being first, to prioritise the most relevant variables.

Table 3: Display of total sample size and success outcomes measured.

| Sample | N | % |
|----------------------------|----------|----------|
| Total Lineouts | 660 | |
| TJs Lineouts | 350 | 53% |
| Opposition Lineouts | 310 | 47% |
| Success | | |
| Won | 448 | 68% |
| Won Scruppily | 92 | 14% |
| Loss | 120 | 18% |
| Delivery Quality | 529 | |
| Clean | 410 | 93% |
| Messy | 119 | 7% |

Table 3a: Descriptive statistics of lineouts by external factors

| External Factors | N | % |
|-------------------------|----------|----------|
| Pitch Location | 660 | |
| 0m-22m | 27 | 4% |
| 22m-50m | 117 | 18% |
| 50m-Oppo22m | 275 | 42% |
| Oppo22m-Oppo0m | 241 | 37% |
| Match Time | 660 | |
| 1stH | 362 | 55% |
| 2ndH | 298 | 45% |
| How Stolen | 117 | |
| Stolen In Air | 50 | 43% |
| Stolen On Floor | 67 | 57% |
| Catch Type | 593 | |
| Clean | 380 | 64% |
| Marked | 95 | 16% |
| Contested | 118 | 20% |
| Weather | 660 | |
| Fair | 434 | 66% |
| Wind | 199 | 30% |
| Rain | 0 | 0% |
| Both | 27 | 4% |
| Pitch Type | | |

| | | |
|---------------------------|-----|-----|
| Grass-Good Quality | 438 | 66% |
| Grass-Bad Quality | 116 | 18% |
| 3G | 106 | 16% |

Table 3b: Descriptive statistics of lineouts by tactical factors

| Tactical Factors | N | % |
|---------------------------------|----------|----------|
| Rep Time | 660 | |
| 1-3s | 138 | 21% |
| 3-5s | 513 | 78% |
| 5-7s | 9 | 1% |
| Lineout Numbers | | |
| 3-5 | 361 | 55% |
| 6-8 | 299 | 45% |
| Lineout Formation | | |
| 1 (3-1) | 5 | 0.8% |
| 2 (1-3) | 16 | 2.4% |
| 3 (1-1-3) | 14 | 2.1% |
| 4* (1-3-1) | 232 | 35.2% |
| 5 (1-3-3) | 2 | 0.3% |
| 6* (3-2) | 75 | 11.4% |
| 7 (2-3) | 20 | 3.0% |
| 8 (2-2-2) | 19 | 2.9% |
| 9 (1-2-3) | 10 | 1.5% |
| 10 (3-3) | 29 | 4.4% |
| 11* (1-3-2) | 203 | 30.8% |
| 12 (2-3-2) | 8 | 1.2% |
| 13 (3-2-2) | 1 | 0.2% |
| 14 (4-2) | 6 | 0.9% |
| 15 (3-2-1) | 9 | 1.4% |
| 16 (3-1-2) | 1 | 0.2% |
| 17 (3-3-1) | 1 | 0.2% |
| 18 (3-3-2) | 3 | 0.5% |
| 19 (3-1-3) | 6 | 0.9% |
| Plus 1 | 660 | |
| Yes | 464 | 70% |
| No | 196 | 30% |
| Dummies/Switches | 200 | |
| 1 | 158 | 79% |
| 2 | 42 | 21% |
| 2+ | 0 | 0% |
| Type Of Dummies/Switches | | |
| Slip | 68 | 34% |
| Bump | 82 | 41% |
| Drop | 50 | 25% |
| Hooker | 660 | |
| Starting | 611 | 93% |
| Bench | 49 | 7% |
| Throw Location | 651 | |
| Front | 233 | 36% |

| | | |
|---------------------------------|-----|-----|
| Middle | 281 | 43% |
| Back | 137 | 21% |
| Unregistered[^] | 9 | |
| <hr/> | | |
| Throw Type | 655 | |
| Lob | 295 | 45% |
| Flat | 360 | 55% |
| <hr/> | | |
| Delivery Type | 531 | |
| Maul | 310 | 58% |
| Off Top | 165 | 31% |
| Pull Out | 56 | 11% |
| <hr/> | | |
| Calling Language | 660 | |
| Trigger | 474 | 72% |
| Pre-Set | 62 | 9% |
| Numeric | 87 | 13% |
| Verbal | 37 | 6% |
| <hr/> | | |
| Tempo | 660 | |
| Artificial | 539 | 82% |
| Genuine | 121 | 18% |

* Due to low data values, only these variables were tested

[^] Some lineouts were unable to determine throw location

Table 3c: Descriptive statistics of lineouts by defensive factors

| Defensive Factors | N | % |
|------------------------------|----------|----------|
| Defence Jump | 660 | |
| Yes | 294 | 45% |
| No | 366 | 55% |
| <hr/> | | |
| Defence Jump Location | 294 | |
| Front | 106 | 36% |
| Middle | 123 | 42% |
| Back | 65 | 22% |

4.2: Regression Analysis

All variables were compared against the outcome (win, win scrappy or loss) using a multinomial logistic regression. In all instances for outcome, the reference category was “lost”. The results of these analyses are presented below ranked by predictive power (Nagelkerke R² value).

4.2.1: Defence Jump

The overall model was statistically significant ($\chi^2 = 76.043$, $df = 2$, $p = < .001$), indicating that the presence of a defensive jump had significant associations with the lineout success outcomes. The model explained between 13.3% of the variance in lineout success, as displayed by the Nagelkerke R² value.

Defensive jumps were a statistically significant predictor of lineout outcome in terms of win vs loss ($p < 0.05$) but was not statistically significant when assessing winning scrappily versus losing ($p > 0.05$).

When assessing winning outcomes versus losing, significant results were identified (95% CI [0.190-0.439], $p = <.001$), where a lineout facing a defensive jump was found to be 0.2 times less likely to be successful when compared to no defensive jump ($B = -1.243$, $OR = .289$).

When assessing winning scrappily versus losing, a lineout facing a defensive jump was found to have increased odds of winning scrappily when compared to no defensive jump ($B = 0.552$, $OR = 1.737$), however these results were found to not be statistically significant, as well as the CI containing 1.00 indicating a high degree of uncertainty in the estimated effects (95% CI [0.953-3.166], $p = .072$).

Table 4: Results of multinomial logistic regression model investigating defensive jump and lineout success (Won vs Lost and Won Scrappily vs Lost).

| Comparison | Predictor | B | SE | Wald | P | OR (ExpB) | 95% CI |
|-----------------------|-----------------|--------|-------|--------|-------|--------------|---------------|
| Won vs Lost | Defence Jump | | | | | | |
| | Jump vs No Jump | -1.243 | 0.214 | 33.633 | <.001 | .289 | [0.190-0.439] |
| Won Scrappily vs Lost | Jump vs No Jump | 0.552 | 0.306 | 3.247 | .072 | 1.737 | [0.953-3.166] |

* Reference Category is "Lost"

OR = Odds Ratio; CI = Confidence Interval; SE = Standard Error; χ^2 = Chi Squared Value; df = Degrees of Freedom

4.2.2: Pitch Locations

The overall model was statistically significant ($\chi^2 = 14.739$, $df = 6$, $p = 0.022$), indicating that pitch location had a significant association with lineout outcomes. This model explained approximately 2.7% of the variance in outcomes, as indicated by the Nagelkerke R^2 value.

Despite a significant model being produced, further investigation revealed pitch location was not a significant predictor of lineout outcome, with no individual comparison reaching statistical significance ($p > 0.05$).

When assessing winning as an outcome versus losing, teams with lineouts in their own 0m-22m were less likely to win compared to lineouts in the opposition 22m-0m, However, these results were not statistically significant and the confidence interval included 1.00, suggesting uncertainty in the direction and strength of the association ($B = -0.91$, $OR = 0.40$, $95\% CI [0.15-1.01]$, $p = .053$). Similarly, lineouts in the own 22m-50m were associated with reduced odds of winning compared to the opposition 22m-0m area, but this result was also not statistically significant ($B = -0.57$, $OR = 0.56$, $95\% CI [0.31-1.00]$, $p = .052$). Teams with lineouts in the opposition 50m-22m were less likely to win compared to lineouts in the opposition 22m-0m, but again these results were not significant ($B = -0.19$, $OR = 0.82$, $95\% CI [0.51-1.31]$, $p = .418$).

When assessing winning scrappily as an outcome versus losing, teams with lineouts in their own 0m-22m were 0.76 times less likely to win scrappily compared to the opposition 22m-0m, but the result was not statistically significant ($B = -0.27$, $OR = 0.76$, $95\% CI [0.20-2.79]$, $p = .68$). Alternatively, lineouts in the own 22m-50m were associated with higher odds of winning scrappily than losing compared to the opposition 22m-0m area, but this result was also not statistically significant ($B = 0.45$, $OR = 1.58$, $95\% CI [0.75-3.33]$, $p = .229$). Similarly, lineouts within the opposition 50m-22m were associated with higher odds of winning scrappily than losing compared to the opposition 22m-0m, but the result was once again not statistically significant ($B = 0.13$, $OR = 1.14$, $95\% CI [0.593-2.22]$, $p = .68$).

Table 5: Results of multinomial logistic regression model investigating the relationship between pitch location and lineout success (Won vs Lost and Won Scruppily vs Lost).

| Comparison* | Predictor | B | SE | Wald | P | OR (ExpB) | 95% CI |
|----------------------------------|------------------------------------|--------|-------|-------|------|--------------|------------------|
| Won vs Lost | Pitch Location | | | | | | |
| | 0m-22m vs Opp22m-0m | -0.916 | 0.473 | 3.749 | .053 | 0.400 | [0.15-1.01] |
| | 22m-50m vs Opp22m-0m | -0.573 | 0.295 | 3.776 | .052 | 0.564 | [0.31-1.00] |
| | 50m-Opp22m vs Opp22m-0m | -0.194 | 0.240 | 0.665 | .418 | 0.823 | [0.51-1.31] |
| Won Scruppily vs Lost | 0m-22m vs Opp22m-0m | -0.274 | 0.664 | 0.171 | .680 | 0.760 | [0.20-2.79] |
| | 22m-50m vs Opp22m-0m | 0.458 | 0.380 | 1.448 | .229 | 1.581 | [0.75-3.33] |
| | 50m-Opp22m vs Opp22m-0m | 0.138 | 0.337 | 0.167 | .683 | 1.148 | [0.593- 2.22] |

* Reference Category is "Lost"

4.2.3: Throw Location

The model was statistically significant ($\chi^2 = 11.055$, $df = 4$, $p = .026$), indicating that the throw location had a significant association with lineout outcomes. The model explained 2.1% of the variance in lineout outcomes, as displayed by the Nagelkerke R^2 value.

The front throw location was a statistically significant predictor of lineout outcome in terms of win vs loss ($p = <0.05$) however, not when considering winning scrappily versus losing which was not statistically significant ($p = >0.05$). The middle throw location was not a statistically significant predictor for any outcomes ($p = > 0.05$).

When assessing winning outcomes versus losing, front throws were found to be 2 times more likely to be successful when compared to a throw to the back. These results were found to be significant ($B = 0.734$, $OR = 2.083$, $95\% CI [1.168-3.716]$, $p = .013$). Additionally, middle throws were also found to have increased odds of winning versus losing when compared to back throws. However, these results were

found to not be statistically significant (B = 0.022, OR = 1.023, 95% CI [0.612-1.709], p = .932).

When assessing winning scrappily outcomes versus losing, front throws were found to have increased odds of winning scrappily versus losing when compared to back throws, but these results were found to not be statistically significant (B = 0.372, OR = 1.450, 95% CI [0.669-3.144], p = .347). Additionally, middle throws were also found to have increased odds of winning scrappily versus losing when compared to back throws, but these results were also found to not be statistically significant (B = 0.022, OR = 1.075, 95% CI [0.538-2.149], p = .838).

The confidence intervals were wide and included 1.00 across most comparisons, indicating a high degree of uncertainty in the estimated effects. An exception was the comparison between front throws and back throws for winning versus losing where the effect was statistically significant and the confidence interval excluded 1.00, indicating a more robust association.

Table 6: Results of multinomial logistic regression model investigating throw location and lineout success (Won vs Lost and Won Scrappily vs Lost).

| Comparison | Predictor | B | SE | Wald | P | OR (ExpB) | 95% CI |
|------------------------------|-----------------------|-------|-------|-------|------|--------------|---------------|
| Won vs Lost | Throw location | | | | | | |
| | Front vs Back | 0.734 | 0.295 | 6.176 | .013 | 2.083 | [1.168-3.716] |
| | Middle vs Back | 0.022 | 0.262 | 0.007 | .932 | 1.023 | [0.612-1.709] |
| Won Scrappily vs Lost | | | | | | | |
| | Front vs Back | 0.372 | 0.395 | 0.885 | .347 | 1.450 | [0.669-3.144] |
| | Middle vs Back | 0.072 | 0.354 | 0.042 | .838 | 1.075 | [0.538-2.149] |

* Reference Category is "Lost"

4.2.4: Types of Deception – Dummies and Switches

The overall model was not statistically significant ($\chi^2 = 3.183$, $df = 4$, $p = .528$), indicating that the type of dummy/switch used did not have significant associations with lineout outcomes. The model explained 1.9% of the variance in lineout success, as displayed by the Nagelkerke R^2 value.

Type of dummies and switches (D/S) was not a significant predictor of lineout outcome with no individual comparison reaching statistical significance ($p = >0.05$).

When assessing winning outcomes versus losing a slip manoeuvre was found to have increased odds of winning when compared to a drop manoeuvre, however, these results were found to not be statistically significant ($B = 0.260$, $OR = 1.296$, $95\% CI [0.492-3.414]$, $p = .599$). It was found when assessing the bump manoeuvre, this had an increased odds of winning when compared to a drop manoeuvre, however again, these results were not significant ($B = 0.853$, $OR = 2.346$, $95\% CI [0.854-6.442]$, $p = .098$).

When assessing winning scrappily outcomes versus losing a slip manoeuvre was found to have increased odds of winning scrappily when compared to a drop manoeuvre, however these results were found to not be statistically significant ($B = 0.377$, $OR = 1.458$, $95\% CI [0.436-4.880]$, $p = .540$). Additionally, when assessing the bump manoeuvre, it was found to have increased odds of winning scrappily than losing compared to a drop manoeuvre. These results were also found to not be statistically significant ($B = 0.799$, $OR = 2.222$, $95\% CI [0.645-7.659]$, $p = .206$).

Table 7: Results of multinomial logistic regression model investigating type of deception (type of d/s: bump, drop, slip) and lineout success (Won vs Lost and Won Scruppily vs Lost).

| Comparison | Predictor | B | SE | Wald | P | OR (ExpB) | 95% CI |
|------------------------------|-----------------------------|-------|-------|-------|------|--------------|---------------|
| Won vs Lost | Type of dummy/switch | | | | | | |
| | Slip vs Drop | 0.260 | 0.494 | 0.276 | .599 | 1.296 | [0.492-3.414] |
| | Bump vs Drop | 0.853 | 0.515 | 2.736 | .098 | 2.346 | [0.854-6.442] |
| Won Scruppily vs Lost | Slip vs Drop | 0.377 | 0.616 | 0.375 | .540 | 1.458 | [0.436-4.880] |
| | Bump vs Drop | 0.799 | 0.631 | 1.600 | .206 | 2.222 | [0.645-7.659] |

* Reference Category is "Lost"

4.2.5: Lineout Numbers

The overall model was statistically significant ($\chi^2 = 10.035$, $df = 2$, $p = .007$), indicating that lineout numbers had a significant association with lineout outcomes. The model explained approximately 1.8% of the variance in outcomes, as indicated by the Nagelkerke R^2 value.

Lineout numbers were a statistically significant predictor of lineout outcome in terms of win vs loss ($p < 0.05$) but were not statistically significant when assessing winning scrappily versus losing ($p > 0.05$).

When assessing winning outcomes versus losing, 3-5 player lineouts were found to be 0.5 times less likely to win compared to 6-8 player lineouts. These results were also found to be statistically significant ($B = -0.629$, $OR = 0.533$, $95\% CI [0.350-0.812]$, $P = .003$).

When assessing winning scrappily outcomes versus losing, lineouts involving 3-5 players were also found to have decreased odds of winning scrappily when compared to 6-8 player lineouts. However, these results were not statistically significant, and the confidence interval includes 1.00, suggesting uncertainty in the

direction and strength of the association (B = -0.259, OR = 0.771, 95% CI [0.440-1.353], p = .366).

Table 8: Results of multinomial logistic regression model investigating the relationship between lineout numbers (number of players involved) and lineout success (Won vs Lost and Won Scruppily vs Lost).

| Comparison | Predictor | B | SE | Wald | P | OR (ExpB) | 95% CI |
|----------------------------------|----------------------------|--------|-------|-------|------|--------------|---------------|
| Won vs Lost | Lineout Numbers | | | | | | |
| | 3-5 vs 6-8 | -0.629 | 0.214 | 8.607 | .003 | 0.533 | [0.350-0.812] |
| Won Scruppily vs Lost | | | | | | | |
| | 3-5 vs 6-8 | -0.259 | 0.287 | 0.818 | .366 | 0.771 | [0.440-1.353] |

* Reference Category is "Lost"

4.2.6: Catch Type

The overall model was not statistically significant ($\chi^2 = 2.214$, $df = 4$, $p = .713$), indicating that the catch itself did not have a significant association with lineout success outcomes. The model explained 0.9% of the variance in lineout success, as displayed by the Nagelkerke R^2 value.

Catch type was not a significant predictor of lineout outcome with no individual comparison being statistically significant (all $p = >0.05$).

When assessing winning outcomes versus losing, a clean catch was found to have increased odds of winning when compared to a contested catch, however, these results were found to not be statistically significant (B = 0.157, OR = 1.170, 95% CI [0.507-2.703], $p = .713$). Additionally, a marked catch was also found to have an increased odds of winning when compared to a contested catch, however these results were also found to not be statistically significant (B = 0.312, OR = 1.366, 95% CI [0.455-4.101], $p = .578$).

When assessing winning scrappily outcomes versus losing a clean catch was found to have decreased odds of winning scrappily when compared to a contested catch, however, these results were found to not be statistically significant (B = -0.389, OR =

0.677, 95% CI [0.248-1.849], $p = .447$). Additionally, a marked catch was found to have decreased odds of winning scrappily versus losing when compared to a contested catch. These results were also found to not be statistically significant ($B = -0.288$, $OR = 0.750$, 95% CI [0.193-2.917], $p = .678$).

Table 9: Results of multinomial logistic regression model investigating the relationship between catch type and lineout success (Won vs Lost and Won Scrappily vs Lost).

| Comparison | Predictor | B | SE | Wald | P | OR (ExpB) | 95% CI |
|------------------------------|----------------------------|--------|-------|-------|------|--------------|---------------|
| Won vs Lost | Catch Type | | | | | | |
| | Clean vs Contested | 0.157 | 0.427 | 0.136 | .713 | 1.170 | [0.507-2.703] |
| | Marked vs Contested | 0.312 | 0.561 | 0.309 | .578 | 1.366 | [0.455-4.101] |
| Won Scrappily vs Lost | Clean vs Contested | -0.389 | 0.512 | 0.578 | .447 | 0.677 | [0.248-1.849] |
| | Marked vs Contested | -0.288 | 0.693 | 0.172 | .678 | 0.750 | [0.193-2.917] |

* Reference Category is "Lost"

4.2.7: Rep Time

The overall model was not statistically significant ($\chi^2 = 5.071$, $df = 4$, $p = .280$), indicating that rep time did not have a significant association with lineout outcomes. The model explained approximately 0.9% of the variance in outcomes, as indicated by the Nagelkerke R^2 value.

When assessing winning outcomes versus losing, lineouts lasting 1-3s were found to have decreased odds of winning compared to lineouts lasting 5-7s. However, these results were not statistically significant ($B = -0.402$, $OR = 0.669$, 95% CI [0.078-5.715], $p = .713$). A rep time of 3-5s was also found to have a decreased odds of winning compared to 5-7s, again this result was not statistically significant ($B = -0.698$, $OR = 0.498$, 95% CI [0.061-4.095], $p = .516$).

When assessing winning scrappily outcomes versus losing lineouts lasting 1-3s were found to have decreased odds of winning scrappily compared to lineouts lasting 5-7s. Although once again this result was not statistically significant (B = -0.526, OR = 0.591, 95% CI [0.034-10.270], p = .718). Additionally, a rep time of 3-5s was also found to have decreased odds of winning scrappily than 5-7s, however this result was also not statistically significant (B = -0.218, OR = 0.804, 95% CI [0.049-13.063], p = .878).

Table 10: Results of multinomial logistic regression model investigating the relationship between rep time and lineout success (Won vs Lost and Won Scrappily vs Lost).

| Comparison | Predictor | B | SE | Wald | P | OR (ExpB) | 95% CI |
|------------------------------|---------------------|--------|-------|-------|------|--------------|----------------|
| Won vs Lost | Rep Times | | | | | | |
| | 1-3s vs 5-7s | -0.402 | 1.095 | 0.135 | .713 | 0.669 | [0.078-5.715] |
| | 3-5s vs 5-7s | -0.698 | 1.075 | 0.421 | .516 | 0.498 | [0.061-4.095] |
| Won Scrappily vs Lost | | | | | | | |
| | 1-3s vs 5-7s | -0.526 | 1.457 | 0.130 | .718 | 0.591 | [0.034-10.270] |
| | 3-5s vs 5-7s | -0.218 | 1.422 | 0.023 | .878 | 0.804 | [0.049-13.063] |

* Reference Category is "Lost"

4.2.8: Pitch Type

The overall model was not statistically significant, ($\chi^2 = 5.044$, df = 4, p = .283), indicating that the pitch type did not have any significant associations with lineout outcomes. The model accounted for 0.9% of the variance in outcome, as displayed by the Nagelkerke R² value.

Pitch type was not a significant predictor of lineout outcome with no individual comparison reaching statistical significance (all p = >0.05).

When assessing winning outcomes versus losing, pitches with grass in good condition were found to have increased odds of winning when compared to 3G

pitches, but these results were found to not be statistically significant (B = 0.419, OR = 1.520, 95% CI [0.892-2.591], p = .124). Pitches with grass in bad condition were also found to have increased odds of winning in comparison to 3G pitches, but these results were similarly found to not be statistically significant (B = 0.205, OR = 1.227, 95% CI [0.639-2.357], p = .538).

When assessing winning scrappily outcomes versus losing, pitches with grass in good condition were found to have increased odds of winning scrappily when compared to 3G pitches, but these results were found to not be statistically significant (B = 0.303, OR = 1.354, 95% CI [0.662-2.771], p = .407). Alternatively, pitches with grass in bad condition were found to have decreased odds of winning scrappily when compared to 3G pitches, but these results were also not statistically significant (B = -0.375, OR = 0.688, 95% CI [0.265-1.784], p = .441).

Table 11: Results of multinomial logistic regression model investigating the relationship between pitch type and lineout success (Won vs Lost and Won Scrappily vs Lost).

| Comparison | Predictor | B | SE | Wald | P | OR | 95% CI (ExpB) |
|------------------------------|-------------------------|--------|-------|-------|------|-------|------------------|
| Won vs Lost | Pitch Type | | | | | | |
| | Grass-Good vs 3G | 0.419 | 0.272 | 2.370 | .124 | 1.520 | [0.892-2.591] |
| | Grass-Bad vs 3G | 0.205 | 0.333 | 0.378 | .538 | 1.227 | [0.639-2.357] |
| Won Scrappily vs Lost | Grass-Good vs 3G | 0.303 | 0.365 | 0.689 | .407 | 1.354 | [0.662-2.771] |
| | Grass-Bad vs 3G | -0.375 | 0.487 | 0.593 | .441 | 0.688 | [0.265-1.784] |

* Reference Category is "Lost"

4.2.9: Presence of Plus 1

The model overall was not statistically significant ($\chi^2 = 4.241$, df = 2, p = .120) indicating that the presence of a plus 1 did not have a significant association with lineout outcomes. The model explained approximately 0.8% of the variance in outcomes, as displayed by the Nagelkerke R² value.

The presence of a plus 1 was a statistically significant predictor of lineout outcome in terms of win vs loss ($p < 0.05$) but were not statistically significant when assessing winning scrappily versus losing ($p > 0.05$).

When assessing winning outcomes versus losing lineouts with no plus 1 were found to be 0.6 times less likely to be successful when compared to lineouts with a plus 1. ($B = -0.450$, $OR = 0.638$, $95\% CI [0.418-0.974]$, $p = .037$).

When assessing winning scrappily outcomes versus losing, lineouts with no plus 1 were also found to have decreased odds of winning scrappily when compared to having a plus 1. However, these results were found to not be statistically significant, and the confidence intervals included 1 suggesting uncertainty in the direction and strength of the association ($B = -0.368$, $OR = 0.692$, $95\% CI [0.387-1.238]$, $p = .215$).

Table 12: Results of multinomial logistic regression model investigating the relationship between the presence of a plus 1 and lineout success (Won vs Lost and Won Scrappily vs Lost).

| Comparison | Predictor | B | SE | Wald | P | OR (ExpB) | 95% CI |
|------------------------------|-----------------------------|--------|-------|-------|------|--------------|---------------|
| Won vs Lost | Presence of a Plus 1 | | | | | | |
| | No Plus 1 vs plus 1 | -0.450 | 0.216 | 4.329 | .037 | 0.638 | [0.418-0.974] |
| Won Scrappily vs Lost | No Plus 1 vs plus 1 | -0.368 | 0.297 | 1.537 | .215 | 0.692 | [0.387-1.238] |

* Reference Category is "Lost"

4.2.10: Calling Language

The overall model was not statistically significant ($\chi^2 = 3.892$, $df = 6$, $p = .691$), indicating that calling language did not have any significant associations with lineout outcomes. The model explained 0.7% of the variance in outcome, as displayed by the Nagelkerke R^2 value.

Calling language was not a significant predictor of lineout outcome with no individual comparison reaching statistical significance (all $p = >0.05$).

When assessing winning outcomes versus losing, trigger calls were found to have increased odds of winning when compared to verbal calls, but these results were

found to not be statistically significant (B = 0.499, OR = 1.646, 95% CI [0.730-3.711], p = .229). Additionally, pre-set calls were also found to have increased odds of winning compared to verbal calls, but these results were also not statistically significant (B = 0.541, OR = 1.718, 95% CI [0.609-4.850], p = .307). Numeric calls were similarly found to have increased odds of winning when compared to verbal calls, but these results were again not found to be statistically significant (B = 0.171, OR = 1.186, 95% CI [0.469-2.999], p = .718).

When assessing winning scrappily outcomes versus losing, trigger calls were found to have increased odds of winning scrappily when compared to verbal calls, but these results were found to not be statistically significant (B = 0.216, OR = 1.241, 95% CI [0.420-3.663], p = .696). Pre-set calls were also found to have increased odds of winning scrappily when compared to verbal calls, but these results were also found to no be statistically significant (B = 0.405, OR = 1.500, 95% CI [0.387-5.814], p = .557). ON the other hand, numeric calls were found to have decreased odds of winning scrappily when compared to verbal calls, but these results were also not statistically significant (B = -0.393, OR = 0.675, 95% CI [0.184-2.473], p = .553).

Table 13: Results of multinomial logistic regression model investigating calling language and lineout success (Won vs Lost and Won Scrappily vs Lost).

| Comparison | Predictor | B | SE | Wald | P | OR (ExpB) | 95% CI |
|------------------------------|--------------------------|-------|-------|-------|------|--------------|---------------|
| Won vs Lost | Calling Language | | | | | | |
| | Trigger vs Verbal | 0.499 | 0.415 | 1.446 | .229 | 1.646 | [0.730-3.711] |
| | Pre-set vs Verbal | 0.541 | 0.530 | 1.045 | .307 | 1.718 | [0.609-4.850] |
| | Numeric vs Verbal | 0.171 | 0.473 | 0.130 | .718 | 1.186 | [0.469-2.999] |
| Won Scrappily vs Lost | Trigger vs Verbal | 0.216 | 0.552 | 0.153 | .696 | 1.241 | [0.420-3.663] |

| | | | | | | |
|--------------------------|--------|-------|-------|------|-------|---------------|
| Pre-set vs Verbal | 0.405 | 0.691 | 0.344 | .557 | 1.500 | [0.387-5.814] |
| Numeric vs Verbal | -0.393 | 0.662 | 0.352 | .553 | 0.675 | [0.184-2.473] |

* Reference Category is "Lost"

4.2.11: Deception - *Dummies and Switches*

The overall model was not statistically significant ($\chi^2 = 3.747$, $df = 4$, $p = .441$), indicating that the presence of and the number of dummies and switches did not significant associations with lineout outcomes. The model explained 0.7% pf the variance in lineout success, as suggested by the Nagelkerke R^2 value.

Presence of a D/S was not a significant predictor of lineout outcome with no individual comparison reaching statistical significance ($p > 0.05$).

When assessing winning outcomes versus losing 0 D/S were found to have increased odds in winning vs losing when compared to 2 D/S. The results were found to not be statistically significant ($B = 0.528$, $OR = 1.695$, 95% CI [0.781-3.678], $p = .182$). Lineouts that involved 1 D/S were also found to have increased odds of winning vs losing compared to lineouts with 2 D/S. This result was also found to be statistically insignificant ($B = 0.172$, $OR = 1.188$, 95% CI [0.518-2.725], $p = .684$).

When assessing winning scrappily outcomes versus 0 D/S had increased odds of winning scrappily versus losing when compared to 2 D/S. These results were not statistically significant ($B = 0.153$, $OR = 1.165$, 95% CI [0.419-3.240], $p = .769$). Lineouts that involved 1 D/S were found to have decreased odds of winning scrappily versus losing, these results were also not statistically significant ($B = -0.034$, $OR = 0.966$, 95% CI [0.321-2.907], $p = .951$).

Table 14: Results of multinomial logistic regression model investigating deception (d/s) and lineout success (Won vs Lost and Won Scrappily vs Lost).

| Comparison | Predictor | B | SE | Wald | P | OR (ExpB) | 95% CI |
|-------------|----------------------|---|----|------|---|-----------|--------|
| Won vs Lost | Dummies and Switches | | | | | | |

| | | | | | | |
|---------------------|--------|-------|-------|------|-------|---------------|
| No vs Two | 0.528 | 0.395 | 1.781 | .182 | 1.695 | [0.781-3.678] |
| One vs Two | 0.172 | 0.423 | 0.166 | .684 | 1.188 | [0.518-2.725] |
| <hr/> | | | | | | |
| Won | | | | | | |
| Scrappily vs | | | | | | |
| Lost | | | | | | |
| No vs Two | 0.153 | 0.522 | 0.086 | .769 | 1.165 | [0.419-3.240] |
| One vs Two | -0.034 | 0.562 | 0.004 | .951 | 0.966 | [0.321-2.907] |

* Reference Category is "Lost"

4.2.12: Defence Jump Location

The overall model was not statistically significant ($\chi^2 = 1.304$, $df = 4$, $p = .861$), indicating that the location of the defensive jump did not have any significant association with lineout outcome. The model explained between 0.5% of the variance in lineout success, as displayed by the Nagelkerke R^2 value.

Location of defensive jump was not a significant predictor of lineout outcome with no individual comparison reaching statistical significance (all $p = >0.05$).

When assessing winning outcomes versus losing, lineouts that faced a front defensive jump were found to have decreased odds of winning when compared to a back jump, however, these results were found to not be statistically significant ($B = -0.001$, $OR = 0.999$, 95% CI [0.441-2.262], $p = 0.999$). Alternatively, lineouts that faced a middle defensive jump were found to have significantly increased odds of winning when compared to a back defensive jump. ($B = 0.321$, $OR = 1.379$, 95% CI [0.604-3.148], $p = .445$).

When assessing winning scrappily outcomes versus losing, lineouts that faced a front defensive jump were found to have increased odds of winning scrappily when compared to a back defensive jump, however, these results were found to not be statistically significant ($B = 0.182$, $OR = 1.200$, 95% CI [0.419-3.439], $p = .734$). Additionally, lineouts that faced a middle defensive jump were found to also have increased odds of winning scrappily when compared to a back jump, however, these

results were also found to not be statistically significant (B = 0.239, OR = 1.271, 95% CI [0.436-3.702], p = .661)

Table 15: Results of multinomial logistic regression model investigating the location of defensive jump and lineout success (Won vs Lost and Won Scruppily vs Lost).

| Comparison | Predictor | B | SE | Wald | P | OR (ExpB) | 95% CI |
|------------------------------|------------------------------|--------|-------|-------|------|--------------|---------------|
| Won vs Lost | Defence Jump Location | | | | | | |
| | Front vs Back | -0.001 | 0.417 | 0.000 | .998 | 0.999 | [0.441-2.262] |
| | Middle vs Back | 0.321 | 0.421 | 0.582 | .445 | 1.379 | [0.604-3.148] |
| Won Scruppily vs Lost | | | | | | | |
| | Front vs Back | 0.182 | 0.537 | 0.115 | .734 | 1.200 | [0.419-3.439] |
| | Middle vs Back | 0.239 | 0.546 | 0.193 | .661 | 1.271 | [0.436-3.702] |

* Reference Category is "Lost"

4.2.13: Weather

The overall model was not statistically significant ($\chi^2 = 3.432$, $df = 4$, $p = .488$), indicating that weather did not have any significant association with lineout outcomes. The model explained 0.6% of the variance in outcome, as displayed by the Nagelkerke R^2 value.

Weather was not a significant predictor of lineout outcome with no individual comparison reaching statistical significance (all $p = >0.05$).

When assessing winning outcomes versus losing, lineouts conducted in fair weather were found to have increased odds of winning v when compared to both wind and rain, but these results were found to not be statistically significant (B = 0.731, OR = 2.076, 95% CI [0.855-5.040, $p = .106$]). Additionally, it was found that lineouts conducted in windy weather had increased odds winning versus losing when compared to both wind and rain, but these results were also found to not be statistically significant (B = 0.508, OR = 1.662, 95% CI [0.663-4.169], $p = .278$).

When assessing winning scrappily versus losing, lineouts conducted in fair weather were found to have increased odds of winning scrappily when compared to both wind and rain, but these results were found to not be statistically significant (B = 0.847, OR = 2.333, 95% CI [0.593-9.176], p = .225). Additionally, lineouts that were conducted in windy weather were found to have increased odds of winning scrappily when compared to both wind and rain, but these results were also found to not be statistically significant (B = 0.503, OR = 1.662, 95% CI [0.663-4.169], p = .278).

Table 16: Results of multinomial logistic regression model investigating the relationship between weather and lineout success (Won vs Lost and Won Scrappily vs Lost).

| Comparison | Predictor | B | SE | Wald | P | OR (ExpB) | 95% CI |
|------------------------------|--------------------------------|-------|-------|-------|------|--------------|---------------|
| Won vs Lost | Weather | | | | | | |
| | Fair vs Wind & Rain | 0.731 | 0.452 | 2.607 | .106 | 2.076 | [0.855-5.040] |
| | Wind vs Wind & Rain | 0.508 | 0.469 | 1.174 | .278 | 1.662 | [0.663-4.169] |
| Won Scrappily vs Lost | | | | | | | |
| | Fair vs Wind & Rain | 0.847 | 0.699 | 1.471 | .225 | 2.333 | [0.593-9.176] |
| | Wind vs Wind & Rain | 0.503 | 0.469 | 1.174 | .278 | 1.662 | [0.663-4.169] |

* Reference Category is "Lost"

4.2.14: Throw Type

The overall model was not statistically significant ($\chi^2 = 1.782$, $df = 2$, $p = .410$), indicating that throw type did not have any significant associations with lineout outcomes. The model explained between 0.3% of the variance in lineout outcomes, as displayed by the Nagelkerke R^2 value.

The throw type was not a significant predictor of lineout outcome with no individual comparison reaching statistical significance (all $p = >0.05$).

When assessing winning outcomes versus losing, lob throws were found to have decreased odds of winning g when compared to flat throws, however, these results

were found to not be statistically significant (B = -0.203, OR = 0.816, 95% CI [0.544-1.226], p = .326).

When assessing winning scrappily outcomes versus losing, lob throws were found to have increased odds of winning scrappily when compared to flat throws, but again, these results were found to not be statistically significant (B = 0.046, OR = 1.047, 95% CI [0.606-1.809], p = .870).

Table 17: Results of multinomial logistic regression model investigating throw type and lineout success (Won vs Lost and Won Scrappily vs Lost).

| Comparison | Predictor | B | SE | Wald | P | OR (ExpB) | 95% CI |
|------------------------------|--------------------|--------|-------|-------|------|--------------|---------------|
| Won vs Lost | Throw Type | | | | | | |
| | Lob vs Flat | -0.203 | 0.208 | 0.956 | .326 | 0.816 | [0.544-1.226] |
| Won Scrappily vs Lost | Lob vs Flat | 0.046 | 0.279 | 0.027 | .870 | 1.047 | [0.606-1.809] |

* Reference Category is "Lost"

4.2.15: Lineout Formation

Due to the sparseness of data within the lineout formations category, a multinomial logistic regression was performed on lineout formations 4 (1-3-1), 6 (3-2) and 11 (1-3-2) due to being the most densely populated variables.

The overall model was not statistically significant ($\chi^2 = 0.711$, $df = 4$, $p = .950$), indicating that lineout formation did not have significant associations with lineout outcomes. The model explained 0.2% of the variance in outcomes, as shown by the Nagelkerke R^2 value.

Lineout formation was not a significant predictor of lineout outcome with no individual comparison reaching statistical significance ($p > 0.05$).

When assessing winning outcomes versus losing the 1-3-1 formation was found to have decreased odds of winning when compared to the 1-3-2 formation. These

results were found to not be statistically significant (B = -0.075, OR 0.928, 95% CI [0.561-1.534], p = .771). The 3-2 formation was also found to have a decreased odds of winning compared to the 1-3-2 formation. Similarly, the results were found to not be statistically significant (B = -0.274, OR = 0.760, 95% CI [0.387-1.493], p = .426).

When assessing winning scrappily outcomes versus losing the 1-3-1 formation was found to have increased odds of winning scrappily when compared to the 1-3-2 formation. However, these results were found to not be statistically significant (B = 0.018, OR = 1.019, 95% CI [0.517-2.007], p = .958). Alternatively, the 3-2 formation was found to have a decreased odds of winning scrappily when compared to the 1-3-2 formation. The results, however, were found to not be statistically significant (B= -0.210, OR = 0.810, 95% CI [0.318-2.066], p = .659).

Table 18: Results of multinomial logistic regression model investigating the relationship lineout formation and lineout success (Won vs Lost and Won Scrappily vs Lost).

| Comparison | Predictor | B | SE | Wald | P | OR (ExpB) | 95% CI |
|------------------------------|--------------------------|--------|-------|-------|------|-----------|---------------|
| Won vs Lost | Lineout Formation | | | | | | |
| | 1-3-1 vs 1-3-2 | -0.75 | 0.257 | 0.085 | .771 | 0.928 | [0.561-1.534] |
| | 3-2 vs 1-3-2 | -0.274 | 0.344 | 0.645 | .426 | 0.760 | [0.387-1.493] |
| Won Scrappily vs Lost | | | | | | | |
| | 1-3-1 vs 1-3-2 | 0.018 | 0.346 | 0.003 | .958 | 1.019 | [0.517-2.007] |
| | 3-2 vs 1-3-2 | -0.210 | 0.478 | 0.194 | .659 | 0.810 | [0.318-2.066] |

* Reference Category is "Lost"

4.2.16: Delivery Type

The overall model was not statistically significant ($\chi^2 = 0.654$, df = 4, p = .957), indicating that the delivery type did not have any significant associations with lineout

outcomes. The model accounted for 0.2% of the variance in outcome, as displayed by the Nagelkerke R² value.

The delivery type was not a significant predictor of lineout outcome with no individual comparison reaching statistical significance (all p = >0.05).

When assessing winning outcomes versus losing, lineouts leading to a maul were found to have increased odds of winning when compared to lineouts leading to a pull out, but these results were found to not be statistically significant (B = 0.213, OR = 1.237, 95% CI [0.563-2.720], p = .597). Additionally, a lineout with a pass off the top had increased odds of winning compared to a pull out, but again, these results were also found to not be statistically significant (B = 0.212, OR = 1.236, 95% CI [0.531-2.880], p = .623).

When assessing winning scrappily outcomes versus losing, lineouts leading to a maul were found to have decreased odds of winning scrappily versus losing when compared to lineouts leading to a pull out, but these results were found to not be statistically significant (B = -0.028, OR = 0.972, 95% CI [0.347-2.721], p = .957). Additionally, a lineout with a pass off the top had decreased odds of winning scrappily versus losing, but these results were also found to not be statistically significant (B = -0.122, OR = 0.885, 95% CI [0.289-2.709], p = .831).

Table 19: Results of multinomial logistic regression model investigating delivery type and lineout success (Won vs Lost and Won Scrappily vs Lost).

| Comparison | Predictor | B | SE | Wald | P | OR (ExpB) | 95% CI |
|------------------------------|----------------------------|--------|-------|-------|------|--------------|---------------|
| Won vs Lost | Delivery Type | | | | | | |
| | Maul vs Pull Out | 0.213 | 0.402 | 0.280 | .597 | 1.237 | [0.563-2.720] |
| | Off Top vs Pull Out | 0.212 | 0.432 | 0.241 | .623 | 1.236 | [0.531-2.880] |
| Won Scrappily vs Lost | | | | | | | |
| | Maul vs Pull Out | -0.028 | 0.525 | 0.003 | .957 | 0.972 | [0.347-2.721] |

| | | | | | | |
|--------------------------------|--------|-------|-------|------|-------|-------------------|
| Off Top vs Pull Out | -0.122 | 0.571 | 0.046 | .831 | 0.885 | [0.289- 2.709] |
|--------------------------------|--------|-------|-------|------|-------|-------------------|

* Reference Category is "Lost"

4.2.17: Match Time

The overall model was not statistically significant ($\chi^2 = 1.039$, $df = 2$, $p = .595$), indicating that match time did not have a significant association with lineout outcomes. The model explained approximately 0.2% of the variance in outcomes, as indicated by the Nagelkerke R^2 value.

Match time was not a significant predictor of lineout outcome with no individual comparison reaching statistical significance ($p > 0.05$).

When assessing winning outcomes versus losing, lineouts in the first half were found to have increased odds of winning compared to those in the second half. However, this result was not statistically significant, and the confidence interval included 1.00, suggesting uncertainty in the direction and strength of the association ($B = 0.20$, $OR = 1.23$, $95\% CI [0.823-1.84]$, $p = .310$).

When assessing winning scrappily outcomes versus losing, lineouts in the first half were found to have increased odds of winning scrappily compared to those in the second half. Again, the result was not statistically significant, and the confidence interval included 1.00, suggesting uncertainty in the direction and strength of the association. ($B = 0.14$, $OR = 1.15$, $95\% CI [0.66-1.98]$, $p = .612$).

Table 20: Results of multinomial logistic regression model investigating the relationship between match time (time within match) and lineout success (Won vs Lost and Won Scrappily vs Lost).

| Comparison | Predictor | B | SE | Wald | P | OR (ExpB) | 95% CI |
|------------------------------|---|-------|-------|-------|------|-----------|--------------|
| Won vs Lost | Match Time | | | | | | |
| | 1st Half vs 2nd Half | 0.209 | 0.206 | 1.029 | .310 | 1.232 | [0.823-1.84] |
| Won Scrappily vs Lost | | | | | | | |
| | 1st Half vs 2nd Half | 0.141 | 0.278 | 0.258 | .612 | 1.151 | [0.66-1.98] |

* Reference Category is "Lost"

4.2.18: Hooker – Start or Replacement

The overall model was not statistically significant ($\chi^2 = 0.196$, $df = 2$, $p = .907$), indicating that a starting hooker and replacement hooker did not have significant associations with lineout outcomes. The model explained 0% of the variance in lineout outcomes, as displayed by the Nagelkerke R^2 value.

The presence of a starting or replacement hooker was not a significant predictor of lineout outcome with no individual comparison reaching statistical significance (all $p = >0.05$).

When assessing winning outcomes versus losing starting hookers were found to have increased odds of winning when compared to a replacement hooker, but these results were found to not be statistically significant ($B = 0.167$, $OR = 1.182$, 95% CI [0.564-2.478], $p = .658$).

When assessing winning scrappily outcomes versus losing starting hookers were found to have increased odds of winning scrappily when compared to replacement hookers, but these results were also found to not be statistically significant ($B = 0.099$, $OR = 1.104$, 95% CI [0.403-3.020], $p = .847$).

Table 21: Results of multinomial logistic regression model investigating hooker (start or replacement) and lineout success (Won vs Lost and Won Scrappily vs Lost).

| Comparison | Predictor | B | SE | Wald | P | OR (ExpB) | 95% CI |
|------------------------------|-----------------------------|-------|-------|-------|------|-----------|---------------|
| Won vs Lost | Hooker | | | | | | |
| | Start vs Replacement | 0.167 | 0.378 | 0.196 | .658 | 1.182 | [0.564-2.478] |
| Won Scrappily vs Lost | Hooker | | | | | | |
| | Start vs Replacement | 0.099 | 0.514 | 0.037 | .847 | 1.104 | [0.403-3.020] |

* Reference Category is "Lost"

4.2.19: Tempo

The overall model was not statistically significant ($\chi^2 = 0.267$, $df = 2$, $p = .875$), indicating that tempo did not have any significant associations with lineout outcome.

The model accounted for 0% of the variance in success, as displayed by the Nagelkerke R² value.

Pitch type was not a significant predictor of lineout outcome with no individual comparison reaching statistical significance (all p = >0.05).

When assessing winning outcomes versus losing, artificial tempo was found to have decreased odds of winning when compared to genuine tempo, but these results were found to not be statistically significant (B = -0.003, OR = 0.997, 95% CI [0.593-1.679], p = .992).

When assessing winning scrappily versus losing, artificial tempo was found to have increased odds of winning scrappily versus losing when compared to genuine tempo, but again, these results were found to not be statistically significant (B = 0.152, OR = 1.164, 95% CI [0.566-2.395], p = .679).

Table 22: Results of multinomial logistic regression model investigating tempo and lineout success (Won vs Lost and Won Scrappily vs Lost).

| Comparison | Predictor | B | SE | Wald | P | OR (ExpB) | 95% CI |
|-----------------------|-----------------------|--------|-------|-------|------|-----------|---------------|
| Won vs Lost | Tempo | | | | | | |
| | Artificial vs Genuine | -0.003 | 0.266 | 0.000 | .992 | 0.997 | [0.593-1.679] |
| Won Scrappily vs Lost | Tempo | | | | | | |
| | Artificial vs Genuine | 0.152 | 0.368 | 0.171 | .679 | 1.164 | [0.566-2.395] |

* Reference Category is "Lost"

Chapter V: Discussion

5.1: Summary

The aim of this study was to identify key technical and tactical factors influencing lineout success outcomes (win, win scrappy, loss) in Nat 2 SE semi-professional rugby union. A wide range of variables were examined, including lineout structure, tactical support and deception, technical execution, positional contest, and contextual factors. The findings indicate that many variables assessed did not have a statistically significant effect on lineout outcome, with regression models demonstrating low overall predictive power. Within this study, the number of players in the lineout (particularly 6-8 player formations), the presence of a plus one, defensive jumping and throw location were the only variables to demonstrate significant relationships with lineout success, with defensive pressure accounting for the greatest proportion of variance (13.3%). This pattern aligns with Morris et al., (2015), who examined a range of structural (e.g. lineout numbers and formations), tactical (e.g. defensive contest) and technical (e.g. throwing and jumping actions) variables in Super Rugby and similarly reported high success rates and limited differentiation between many commonly analysed technical variables. Their findings, like those of the present study, suggest that collective structural and tactical elements rather than isolated technical actions are more influential in determining lineout success.

5.2: External variables

Despite the large number of lineouts processed ($n = 660$) the multinomial logistic regression did not yield statistically significant associations between the external variables (i.e. pitch location, match time, how stolen, catch type, weather, pitch type) and success. This may highlight a genuine absence of strong relationships in the data. Despite this lack of significance, information can still be drawn from the results. While Pitch location generated a statistically significant model, the specific locations were found to not be statistically significant. This result could be explained by the majority of lineouts taking place within the oppositions half (50m-opp22m = 275, opp22m-0m = 241) and very few occurring within the attacking team's half (0m-22m = 27, 22m-50m = 117). This is likely related to teams opting to kick the ball into touch when receiving a penalty, which lines up with the idea that teams that kick more

create more opportunities to score, and therefore increase the odds of winning the match outright (Callinan et al., 2024). This is a coached tactical decision-making process highlighted in teams as far back as the 2014-15 Aviva Premiership season in which captains opted not to kick for goal 226 times over 41 matches (5.5 instances per game) (Rugby Wrap Up, 2015). Match time highlighted little variation in lineout success within each half of the game, which is emphasised by the lack of significance. Although research directly examining the relationship between match time and set piece success in rugby union is limited, studies in other sports have found contradicting results. A study to draw comparison from is by Skinner, (2010) who found that inbound play success decreased in the later stages of a basketball game, due to defensive, or score line pressure and player fatigue. Although not directly related to the set piece this highlights the potential for fatigue to reduce the rates of successful actions within team games. This is also echoed in American football, highlighting a decrease in field goal accuracy in the latter minutes of the game, again likely due to fatigue and psychological pressure to perform well (Romer, 2006). Within this study there are a number of potential reasons for this to occur, firstly the level (NAT 2 rugby union) should be considered with the overall fitness of players being of a lower standard than those found within the league. Although this is a factor to be aware of the, the non-significance of the results could be related to the fact that over half (55%) of the lineouts occurred within the first half meaning the fatigue may not have fully accumulated enough to be a significant factor. Additionally, tactical considerations may have influenced lineout success, with teams potentially opting for safer, lower-risk options than aggressive plays, particularly if the score line was uneven.

Weather was a factor affected by sparseness within the recorded variables, the majority of matches within the season were played in fair weather conditions (n = 434) while a smaller number were undertaken in windy conditions (n = 199) and both wind and rain (n = 27) and none in solely rain. Whilst the results of the linear regression assessing weather and outcome found that lineouts conducted within fair weather were more likely to be successful than those performed within both wind and rain, this was not significant. Quarrie and Hopkins, (2007) reported similar condition related results, and an increase in success with play in fair weather conditions., and Colomer et al. (2020) found that adverse weather conditions

negatively influenced overall team performance. It is likely results were insignificant in this study due to the sample, so whilst this study presents some preliminary results, a more representative sample of all weather conditions should be used in future studies to assess accurately whether fairer conditions truly lead to more successful outcomes.

Pitch type/surface was a result that was most likely non-significant due to the retention of pitch quality (grass-good quality = 438) and a smaller sample size of poor-quality pitches (grass-bad quality = 116) and a lack of teams using astro-turf pitches (3G = 106). The relationship between pitch quality and success of play, more specifically lineouts is an understudied sector that may potentially have great effect. Interviewee 2 expressed the potential importance of pitch type: “yeah, we are we playing? Is it the Slade? Is it on Astro?”. Hughes, (2021) supports this notion by discussing the frequency of 3G artificial turf pitches being employed within rugby in recent years increasing as a method to address poor pitch conditions. The effect of this increase has had a noted effect on decreasing the frequency of player injuries as well as improving player performance (Hughes, 2021). Therefore, suggesting that there is potential for an overall effect on success of a team and therefore the lineout posed by 3G pitches which was not reflected within the results of this study.

The disparity between frequency of pitch conditions could potentially be explained in tandem with the weather results. The primacy in fair weather conditions was an accurate reflection of the weather conditions throughout the year, with a relatively dry winter being the main cause. Therefore, the conditions of the grass were relatively preserved, which was particularly poignant in the case of TJs whose pitch typically floods in the winter making the pitches unplayable. This may explain the fact that both fair weather (OR = 2.076) and grass in good quality (OR = 1.520) both reporting marked increases in lineout success odds.

Although external variables showed no statistically significant effect on lineout success, trends suggest tactical decisions, fair weather, and good-quality pitches shaped outcomes. Match time showed little influence, possibly due to closely contested games or strategic pacing. These results indicate that while external factors set the context, team strategy likely plays a more direct role, which the following section explores through tactical factors.

5.3 Tactical Factors

Tactical factors represent the strategic and technical decisions coaches/players make to influence the way in which a lineout is carried out and subsequently the success as revealed by the results. While a predominant portion of variables analysed were found to be non-significant there were three result sets that were found to significantly influence success. Lineouts involving 6-8 players emerged as a statistically significant predictor of lineout success in terms of outright wins to losses ($p < 0.05$). This finding aligns with Morris et al., (2015), who reported that lineout success was more closely associated with structural decisions, such as the number of players committed to the lineout (e.g. 5, 7 and 8-man lineouts). This suggests that an increased number of players committed to the lineout influences the likelihood of securing clean possession. However, lineouts involving 6-8 players were not statistically significant when differentiating between winning scrappily versus losing ($p > 0.05$), indicating that while formation size affects overall success, it may not necessarily affect a contested lineout.

While the consensus to be drawn from this study is that lineouts containing more players (6-8) are more likely to be successful than lineouts involving less players (3-5), this is most likely related to other situational elements within the game. One such example is the relationship between lineout numbers and pitch location. Although there is limited existing research specifically examining the relationship between lineout numbers and pitch location, a qualitative insight from one coach yielded earlier in the study supported this notion “obviously numbers in the lineout depend on where you are on the pitch, the negative side of numbers is shortening the lineout” (Interviewee 3,). While pitch location itself was not a significant predictor within this study, the descriptive data outlined a higher frequency of lineouts taking place within the opposition half and 22m zone. When assessing the frequencies of lineouts it was found that 6-8 player lineouts were more common within the opposition 22m line (66%) which in turn reflects the statement of the coach. This pattern suggests that that increased lineout numbers in these areas may be related to tactical decisions based on both maximising chances of gaining possession. This may also be related to tactical decisions based on reducing the number of available opposition players in defence which was a tactical aspect mentioned by Interviewee 3 “so as you shorten the lineout, there are more defenders on their feet”. Overall,

these findings indicated that lineout numbers, particularly involving 6-8 players, are not only a statistical determinant of lineout success but also highlight broader tactical considerations within the lineout decision-making process. This highlights a cross over in relationship between lineout success and further team success (i.e. scoring a try).

When looking at the significant results for numbers of people involved in the lineout, the formation results can also be assessed. Although the regression model between formation type and outcome was non-significant, the descriptive results, point towards increased usage of 5 player formations (1-3-1 = 232, 3-2 = 75) and 6 player formations (1-3-2 N = 203). A similar pattern was identified by Morris et al., (2015), who found that elite teams were not distinguished by formation selection alone, but by how formations were utilised to generate forward dominance and or continuity of possession, particularly through situational use across different areas of the pitch (e.g. smaller 4-5 man formations being employed more frequently in the defensive half). Although non-significant, the analysis revealed that the 1-3-2 formation was more successful than both the 1-3-1 formation and the 3-2 formation which were both 5 player formations. This aligns with the previous significant findings implying a primacy in 6-8 player formations. The primacy in 5 and 6 player formations is reflected by the findings of Migdalski and Stone (2019) who reported that Premiership teams most frequently employ 5 and 6 players formations (~70% of recorded lineouts) with no significant difference between the top and bottom teams. Crucially, however, the analysis differed from this study showing that more successful teams were distinguished not by formation choice but by choices made during and after the lineout, with teams that displayed more forward dominance being found to have greater overall match success (Hughes and White, 1997). It was found that the more successful teams were favouring binding and transitioning into mauls which are typically executed from larger formations as shown by the formation preferences found by Migdalski and Stone, (2019). These findings are in turn reflected within this study, as the reported delivery types showed the largest portion of lineouts lead to a maul (n = 310). This is further supported by the analysis which found that, although non-significant, lineouts including maul deliveries were more successful than pull out options (OR = 1.2x more successful) and more successful than off the top options compared to pull out options. This is reflected within the

findings of Migdalski and Stone, (2019) in which the top teams tended to maul more while the bottom Premiership teams were less successful. Taken together, these findings suggest that while formation choice alone may not statistically differentiate successful and less successful teams, larger lineouts provide the structural platform for binding and mauling actions that underpin possession security and attacking continuity. This reinforces the surrounding body of evidence that the effectiveness of the lineout lies less in numerical arrangement and more in how larger formations are utilised to generate forward dominance and therefore scoring opportunities (Coughlan et al., 2019).

Significant results were also revealed for the inclusion of a plus one, where it was found that including a plus one in a lineout was associated with a significantly ($p < 0.05$) higher probability of winning a lineout. However, when assessing scrappy wins, the same findings were non-significant ($p > 0.05$) suggesting no effect. It can therefore be said that having a plus one present positively influences success within the lineout, however the plus one role is not involved within the repetition itself but acts as a means of delivery after success. The presence of a plus 1 having a significant positive effect on overall lineout success could be related to several concurrent factors within each lineout. One such factor is related to the planning of the lineout. Whilst there is a lack of research directly related to the role of the plus one, most lineouts involving a plus one lead to a maul being formed. The pre-planning of a lineout leading to a maul aligns with the same positive effect found from set-play planning and organisation as found by Coughlan et al. (2019). This in turn suggests that the presence of a plus one is both a beneficiary and a cause of a successful lineout. In support of this, Coughlan et al. (2019) also found that lineouts leading to mauls in the 22m zone were the most prominent combination leading to scoring in rugby union, highlighting it is a sport wide tactic that is known to lead to success. This is reflected in the pitch location results within this study, in which it was found that odds of success increased within the oppositions 22m zone compared to any other pitch zone (however it is important to note that this was not significant). As well as this, the high frequency of mauling options chosen within the lineout as well as larger formations accommodating a plus 1s inclusion all highlight the positive effects of a forward dominant trend discussed previously. Therefore, it can be said that the presence of plus 1, a situational factor that benefitted off a number of other

factors occurring concurrently to that lineout as well as contributing to overall success of the lineout by being part of the organisational structure associated with mauling.

Analysis of throw location revealed that the location within the lineout had a significant impact on success rates. It was found that throws directed at the front of the lineouts were more likely to result in success than middle or back throws. This differs from the findings of Sayers, (2011) in which it was found there was no difference in success rates when considering throw location. It is therefore possible that it might not necessarily be related to the location but the thrower. Sayers, (2011) found that location influenced the technical demands of the throw as opposed to the accuracy of the players, suggesting that it is related to the quality of the thrower. While Sayers, (2011) employed elite players, NAT2 rugby union is a semi-professional league, therefore meaning the quality of players were lower and therefore may not have been able to meet the demands of the different throwing locations, therefore explaining why the front throw was most successful. While the status of hooker (starting, bench) was not a statistically significant variable in this study, it was found that starting hookers enjoyed more success within the lineout throw than bench hookers. Additionally, the split between instances of starting/bench throws was considerable (Starting = 611, Bench = 49), which both present a notion that teams primarily rely on their starting hooker rather than the substitute. Previous research has shown that forward substitutes, including hookers, are generally more active when they enter the game, registering more total, attacking, and defensive involvement per minute than the starters they replace (Michael et al., 2019). This highlights a contrast in the reliability of starting a substitute player between NAT2 rugby union and international rugby which is to be expected. This was highlighted by Interviewee 1 “You need to win that ball because if you lose it, you’re under a lot of pressure” and Interviewee 3 “It all depends on the technical ability of the thrower” who emphasised on the quality and the skill set of the hooker in question. The lower quality of hookers therefore will explain the primacy in front throw success within the results since there is less demand on the throw therefore partially mitigating the need for quality skill to ensure success.

Throw type, was also a non-significant variable, however descriptives did highlight a preference in flat throws over lob throws (Flat N = 360, Lob N = 295). This is related

to the throw type preference of the hooker which was initially mentioned by interviewee 1; “What does he (hooker) like? Is he good at throwing flat, nasty balls?”. This potentially explains the preference of a flat throw over a lob throw however this is not necessarily a desired pattern by coaches. Interviewee 3 mentions “So you know, you’re not always going to be in front of the jumper. So, if you’ve got a very good throw of the ball, obviously lob throws are a very technical throw but going over the top of a jumper in front is one of the skills a hooker should have”. The results suggest that flat throws were preferred as jumpers were able to beat the opposition to the catch, therefore highlighting a lower skill set required to execute these throws. The apparent lower success rate of lob throws corroborates with the increased demand on skill set and lower quality in hookers, both starting and bench. This aligns with the biomechanical findings of Trewartha et al. (2008), who found that lob throws require significantly more vertical body motion, greater involvement of lower limbs and tighter control of release angle than flat throws therefore meaning a greater demand in skill and coordination. Trewartha et al. (2008) also found that less skilled throwers in this study exhibited a greater variability in lob throws especially at longer distances. This in turn may explain the preference of front, flat throws over lob throws, and middle or back locations due to it being a less skill intensive throw to make. This however is a potentially coachable issue combining action observation (AO) with conventional practice which has shown to significantly improve lineout throwing accuracy and kinematic control in elite rugby players (i.e. increased arm and ball velocity, reduced release variability) (Faelli et al., 2019). Such approaches could therefore be used by coaches at NAT2 level to enhance the proficiency of available hookers in executing lob throws, reducing the reliance on flat throws and expanding tactical options at the lineout.

Deception was a common occurrence within the total sample of lineouts, with one D/S (n = 158) being the most frequently used, followed by two dummy switches (n = 42). Although lineouts containing one D/S appeared more often and lineouts with two dummy D/S showed a higher proportion of scrappy wins, statistical analysis indicated no significant effect of the number of D/S on lineout success. With this said there is still emphasis placed on the importance of D/S as highlighted by Interviewee 3, who highlighted the preference of “precise short movement and a dummy before you go up”. This may explain the higher number of 1 D/S due to it likely being a

coaching decision. Although there is limited research on deception in lineouts, studies investigating the use of deception in play have highlighted a clear tactical advantage that can be gained. Analysis of decoy tactics in the scrum such as hands up, line change and hands up were noted to significantly improve the likelihood of gainline success (Sherwood et al., 2018). This therefore underlines how even simple deceptive actions can mislead defenders and create opportunities. Additionally, a virtual reality study of perpetual deception in rugby revealed that good quality defenders are better at detecting authentic body motion and avoid being fooled by exaggerated movements (Brault et al., 2012, Lynch et al., 2019). These findings especially reflect in the views of interviewee 3's emphasis on the need for simplistic and limited deceptive manoeuvres within the lineout. Together these studies highlight the potential for a single dummy (1 D/S) to effectively distort defender timing, which may result in cleaner wins, while multiple dummies (2 D/S) may result in more scrappy outcomes where defenders adapt and the outcome becomes more contested.

Furthermore, the research suggests the frequency of D/A within the lineout has pointed towards a simpler, more minimalist approach. Whilst Sayers, (2011) mentioned the potential for using a "dummy lift" within the lineout to delay defender timing, there is very little looking into the type of manoeuvre. Within this study, three main generalisations were made about typical manoeuvres used by TJs and other teams, with the bump manoeuvre being the most common type used (N = 82). This was reflected by the OR only suggesting a higher rate of success within bump manoeuvres as well as slip manoeuvres, however these results were not statistically significant. This highlights the potential for a success-based primacy in forward moving moves within the lineout. These results mirror the views of interviewee 1; "And so anything where the jump is coming forward and it's a speed movement well that works really well" suggesting that for this coach, there is a strong basis for forward moving quick manoeuvres within the lineout to boost success. The speed of manoeuvre however is not reflected within the rep times of the lineout. The results did reveal that the OR were higher for success in lineouts lasting 5-7s being more successful, however these were non-significant. These results allude toward a notion a longer lasting lineout, i.e. with a degree of traveling, or a longer pause before the trigger may be successful. However, the bump is typically a quick manoeuvre which

therefore suggests that a quick movement after a longer preparation phase may increase odds of success. This is a notion assessed by Lautenbach et al. (2015) suggesting a longer preparatory phase can set the stage for quick, effective execution within tennis. Additionally, Wergin et al. (2020) found that a pre performance routine including behavioural actions such as, bouncing the ball before serving increased accuracy. This is a concept that may well play a role in rugby itself with different tempos leading up to the lineout either being genuine or artificial.

Whilst the tempo findings in this study did not yield significant differences, the concept remains important when considered alongside the effectiveness of manoeuvres such as bump and slip. The results of the analysis have suggested that longer lasting lineouts, often incorporating manoeuvres to delay a defensive trigger, may set the foundation for quick decisive action. This aligns with the literature suggesting that an extended preparatory phase can facilitate rapid, effective movements (Lautenbach et al., 2015) and that pre-performance routines can enhance execution (Wargin et al., 2020). However, this contrasts with the applied perspective offered by Interviewee 1, who stated that “that means we'll run in really quick, and we'll just take one on the five metres. Our nine's got a half decent pass, and we'll just take that ball because most teams give you it.”. This highlights an alternative approach championing a quicker tempo and immediate action leading up to and during the lineout not including a solid preparatory phase, however, it is important to remember that coaching philosophy is not universal, and what this coach sees as “successful” may not be the same for other coaches.

Finally calling language was assessed, focusing on the efficacy of different phrases or words called out to determine which deceptive manoeuvre was to be used, where the ball was to be thrown and even delivery type prior to performing the lineout. However, the results of the regression found no significant effect of calling language on outcome. When assessing the interview data, Interviewee 1 placed emphasis on the importance of calling language within his coaching philosophy of the lineout “calling language is really important, it can make or break your lineout, however there is a very little, to no research that has been conducted on the subject”. Of all the calling languages used, trigger calls (N = 474) were the most common language type used, typically consisting of a “yes” or “no”, the exact meaning of which was determined prior to walking into the lineout. This clear preference for a simplistic

approach is one endorsed by former professional rugby player Shane Byrne who advised keeping calls simple and universally understood by players, supported by a small set of reliable calls for specific situations (Planet Rugby, 2022). This is further supported by the regression results in this study highlighting that a trigger call has a higher odds of clean success (OR = 1.6x) when compared to a verbal call, however it was not as high as pre-set calling (N = 62) that had a higher odds of success (OR = 1.7x) within the same comparison, yet these were not significant. Trigger calling was the largest sample potentially explaining the marginal difference. In summary, although calling language was not statistically significant, the consistent reliance on trigger calls supported by both coaches and professional players alike, highlights the perceived importance. This reinforces the idea that while quantitative data-based evidence may be inconclusive, the importance of calling language cannot be overlooked and therefore highlights the need for potential deeper research.

Overall, these findings emphasise that lineout success is influenced by a complex interplay of tactical decisions, formation size, inclusion of a plus one, throw location and potentially other contextual factors, rather than solely being determined by individual player characteristics. The findings of this study are distinctive, as an abundance of existing research assesses the relationship between individual player characteristics (i.e. height, body mass) and success within specific lineout actions, such as jumping/movement mechanics or lifting force (Smith et al., 2018, Wood et al., 2018). In contrast, this considers a broader range of tactical variables, offering a more holistic perspective on the factors influencing lineout outcomes.

5.4 Defensive Factors

The defences reactivity to a lineout once analysed proved to be a significant variable in terms of overall success. The results of this study found that the presence of a defensive lift significantly reduced the overall odds of success in the attacking lineout. These findings primarily align with the surrounding research at elite level in which it was found that the presence of a defensive jump reduced chances of success, underlining the disruptive properties of well-timed contests from the opposition (Migdalski and Stone, 2019). This finding parallels Morris et al., (2015), who determined executing a concurrent a defensive lift at the time of lineout execution was one of the strongest disruptors of lineout success at an elite level. The

present study extends this evidence to a semi-professional context suggesting that defensive organisation and timing remain critical determinants regardless of competitive level. While in the game several factors will influence the timings of the lineout i.e. manoeuvring and tempo, it is likely that a well prepared and informed defence maybe the key for the greatest amount of disruption to the attack. This effectiveness from the defensive lift could be down to a number of reasons, such as one discussed with interviewee who stated that “the problem with the system we use is that everyone sees each other’s video every week and audio is very clear for everyone to hear” which implies that a defence can be successfully assisted by analysis of previous lineout repetitions. A study conducted by Smith et al., (2018) shows that while biomechanical factors such as lift force and jump mechanics are important, the timing and lifting cues within the lineout also require the jumper to rely on anticipation and preparation prior to jumping. Colomer et al., (2020) emphasises the need for an in-depth analysis of lineouts, focusing on why the lineout was lost in order to inform the development of a well-organized lineout, which could be applied in both attack and defence to ensure that jumpers are as well-equipped as they can be. While not related to set pieces, Hendricks et al., (2013) conducted a detailed analysis of 2,394 tackle events across 21 elite level matches establishing that a fast-moving reactive defence during a match was most successful defensive strategy. Taken together, these findings indicate that the effectiveness of defensive lifts lies not only in the physical contest for the ball, but also in the speed, anticipation, and depth of preparation that allow defenders to read attacking cues and position themselves for maximal disruption.

Although defensive jump location was not statistically significant, it offered an insight into defensive jump positioning and lineout success. The results showed that the middle was the most common place for a defence to jump ($n = 123/294$) with front being the second most common ($n = 106/294$) and back being the least common. This was reflected by the OR suggesting that front and middle lifts were more successful than back, however the analytical results were found to be nonsignificant. This contrasts the lineout throw location results in which it was found that a front throw was the most successful location to throw to. This may be related to the fact that defences were being influenced to lift in the wrong part of the lineout, however the lack of significance again prevents the certainty of this. While discussing the

manipulation of a defence, Interviewee asked “How can we make defenders make decisions? Any then we try to make them make the wrong one, right?”. This may provide some insight into the coached mindset of trying to deceive a defence. As previously discussed, the use of decoy jumpers in the lineout is a viable option to increase the likelihood of success; this parallels with the findings of Sherwood, (2019). Research on rugby decision-making has shown that defenders are vulnerable to deceptive cues (D/S) such as decoy runners, who deliberately attract attention and create momentary inattentive blindness, increasing likelihood of defenders committing to ineffective options (Sherwood, 2019). Furthering the concept that defensive lifts that are triggered in certain locations, i.e. middle or back will leave space open for the catch to take place uncontested. This is also consistent with the findings that a singular “bump” manoeuvre consisting of quick forward movements within the lineout lead to the most amount of success. This therefore suggests that a dummy in the middle of the lineout to trigger a defensive lift with the catch at the front would lead to the most successful outcomes. However, if the defence reads the movement and lifts at the front the likelihood of success decreases.

5.5 Limitations and future research

Although this study provides important insights into the determinants of lineout success, several limitations must be acknowledged. While the overall dataset was large, the lack of variance in some results, combined with the use of a multinomial modelling approach, that required separate equations for each outcome relative to the reference, meant that the effective sample size was considerably reduced for certain categories. This reduction limited the precision of the estimates and made it more difficult to detect statistically significant effects, particularly in cases where outcome categories were unevenly distributed. Another limitation was the presence of sparse data for certain variables. For example, the variable “how stolen” was represented by a relatively small number of cases due to its occurrence as a limited cause of unsuccessful lineouts. This restructured its analytical value and ultimately led to its exclusion from the models. Additionally, not all variables were consistently recorded across lineouts, which inhibited the scope of comparisons that could be

made and the comprehensiveness of the analysis. Smaller subsamples also restricted the robustness of findings. Certain variables such as D/S were underrepresented (N = 200/660), with only a limited proportion of lineouts containing this event. The small sample size reduced the overall predictive probability and variance, making it difficult to draw on reliable conclusions from the outputs. For future research, a more targeted analysis of specific lineout scenarios such as D/S frequencies and types may be more appropriate than attempting to incorporate them into broader models. This is also applicable to many variables within this study that were revealed to be nonsignificant contributors to lineout success.

Another such example was the significance of the defensive lift location subsample. While there was significant evidence to suggest that the presence of a defensive lift itself negatively affected success, the location was only documented in 294 out of 660 lineouts (44.4%; front = 106, middle = 123, back = 65) highlighting the smaller data set, as well as the low variability of the lifting locations. Some variables such as lineout numbers and rep time had to have subsamples combined due to sparseness in specific categories and certain variables such as lineout formation subsamples had to be filtered out leaving specific formations with a high enough density for effective testing. This further limited the context that the initial significant result would require in order to make it more useful to coaches and analysts.

To combat these limitations posed by the sparseness of data associated with certain variables, future research could therefore involve a stepwise multinomial logistic regression, which runs combined sets of variables within a single model. This would provide control for confounding variables between predictors, to improve accuracy of the predictive outputs by selecting only those factors that genuinely contribute to lineout outcome thus providing a more concise set of results specifically related to the aims of the study. This approach would also streamline the process of identifying the key variables most likely to influence lineout success, producing more targeted and actionable results. However, the stepwise approach also carries limitations to be aware of, most notably the potential loss of variable-specific insights from the non-significant variables i.e. the loss of the non-significant pitch locations only leaving lineouts on or within the 22m line therefore limiting the critical discussion that could potentially take place and therefore reducing the amount of potential solutions/improvements that could be considered.

Another issue arose with the measurement of delivery quality, which was recorded in relation to a successful lineout. This in turn highlighted the limited applicability of this variable to the aims of this study, as it was a product of success rather than a contributor. This dependency on success therefore, reduced the size of the sub sample and further reducing the number of usable cases and prevented delivery quality from being modelled as a dependent outcome. Future research might address this by focusing on the delivery quality and isolating the variables within the lineout that may affect it.

Finally, there is currently a dearth in availability of academic research on lineouts, and a virtually non-existent established literature base to contextualize these findings. As a result, insights were primarily drawn from practitioner expertise, particularly coaches. While this approach, previously used by a few studies such as Hendricks et al., (2020), Mackay et al., (2023), adds applied relevance, the need for further foundational research to systematically investigate lineout dynamics and established evidence-based frameworks for analysis has been highlighted. Whilst this study may provide a foundation for standardised definitions and frameworks, future research should look to build on this and provide a more detailed evidence base.

Furthermore, the dataset was drawn exclusively from teams competing in the National 2 SE rugby union league, and the patterns observed may differ in higher or lower leagues where tactical approaches, player skill levels, and team structures vary, potentially affecting both the variance and generalisability of the findings. These limitations underscore the preliminary nature of the findings and suggest caution in generalising the results beyond the current dataset. However, the consistency between the present study and the findings of Morris et al., (2015) suggests that key structural determinants of lineout success, such as formation size and defensive contest, may be relatively consistent across competitive levels, despite difference in player skill and tactical execution.

Chapter VI: Conclusion

The aim of this study was to examine the technical, tactical, and contextual determinants of lineout success in National 2 (NAT2) semi-professional rugby union. Through the analysis of 660 lineouts, a broad set of variables were assessed, including formation size, numbers of players involved, tactical deception, throw location, throw location and type, delivery type and quality, defensive contest, and external contextual factors such as weather, pitch type, and match time. While the regression models overall yielded low predictive power, several significant findings emerged that provide valuable insights into the effect of these variables on lineout success.

Specifically, lineouts involving 6-8 players demonstrated higher odds of success compared to those with fewer players, reinforcing the importance of committing greater resources to the set piece. The inclusion of a plus 1 significantly increased the success probability, underscoring its role in securing continuity, often through facilitating maul formation. Throw location proved a key determinant in success, with front throws being significantly more successful than those directed to the middle or back. Finally, defensive lifts were found to have a marked disruptive influence, substantially reducing the likelihood of a successful outcome. Collectively these results emphasise the collective influence of both organisation and defensive pressure in shaping lineout outcomes.

Although many variables tested did not yield statistically significant effects, their descriptive patterns provided additional insights. For example, deceptive manoeuvres and tempo manipulation appeared to influence outcomes despite non-significance, aligning with the coaches' qualitative perspectives gathered from the interview process. Similarly, while external variables such as weather, pitch surface and match time were not significant predictors, with the frequency of distributions suggesting potential situational effects that may emerge with more diverse samples. When considering these findings collectively, the most successful lineout scenario at this specific level appears to involve a 6-player formation (1-3-2) incorporating a plus one, executed with a genuine tempo and including a singular deceptive manoeuvre (ideally a bump) following a longer preparation and action phase of 5-7 seconds. This approach enables teams to manipulate defensive anticipation, triggering

opposition lifts to middle or back of the lineout before executing a flat throw to the front, which in turn provides a secure platform for a maul. Conversely, the presence of a defensive lift significantly undermined success, reaffirming the importance of unpredictability and variation in attacking strategies to neutralise defensive contests.

Despite the insights gained, several limitations must be considered within the interpretations of these findings. Sparse data for certain variables, reduced effective sample sizes due to modelling constraints and potential inconsistencies in recording practices related to human error restricted the reliability of the analytical process. Moreover, the dataset was drawn exclusively from NAT2 rugby, which limits the generalisability of the results across higher or lower competitive leagues where player skill, tactical sophistication, and physical demands vary considerably. Future research should therefore expand the sample to include teams across multiple leagues, enabling cross-league comparisons and more robust statistical testing of currently underexplored variables.

In conclusion, this study represents one of the first systematic efforts to investigate the determinants of lineout success in rugby union, offering both empirical and applied insights. While highlighting key predictors such as player involvement, plus one involvement, throw location and defensive pressure, it also identifies methodological challenges and a dearth in the current research base. These findings provide an initial framework for coaches seeking to optimise lineout success via the use of certain strategies and for researchers aiming to develop more comprehensive, evidence-based models of set piece performance. Ultimately, this study underscores the complex, multifactorial nature of the lineout and lays the groundwork for future research to refine and extend the understanding of one of rugby union's important aspects.

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